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JANUARY TO JUNE

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Authors' Index

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Illustrated articles are designated by an asterisk (*), editorials by dagger (†), and industrials by double dagger (‡).

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Devoted to the Conversion, Transmission and Distribution of Energy

JOURNAL OF ELECTRICITY

VOL. XXXVIII No. 1 SAN FRANCISCO, JANUARY 1, 1917 PER COPY, 25 CENTS

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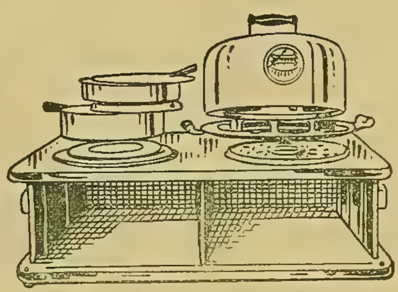

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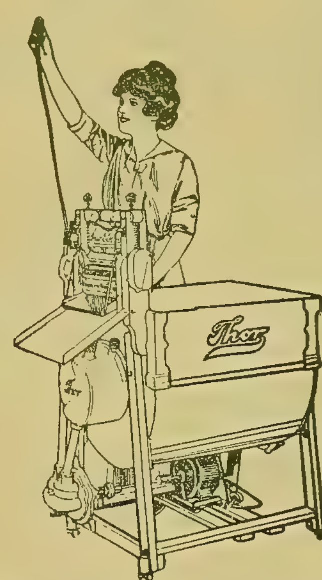

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Devoted to the Generation, Transmission and Utilization of Energy

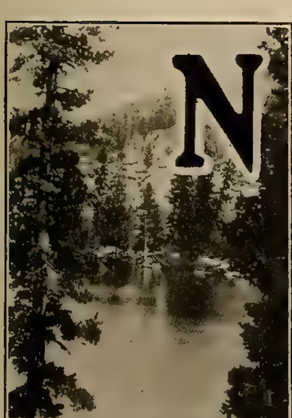
VOLUME XXXVIII | SAN FRANCISCO, JANUARY 1, 1917 | NUMBER 1

The Spillway at the Intake of the Las Plumas Power Plant.

RECENT ELECTROCHEMICAL DEVELOPMENTS

BY J. W. BECKMAN.

(Electro-chemical utilization of water power in the West has long been heralded as of immense importance to economic use of her gigantic water powers. Herein is an article describing the first successful Western electro-chemical plant, written by the electrical engineer employed in its design.—The Editor.)



Lake Storage in High Sierras.

NOT much more than a generation ago the Pacific Coast was primarily interested in gold mines and the necessities of life, such as flour and meat, as well as clothing.

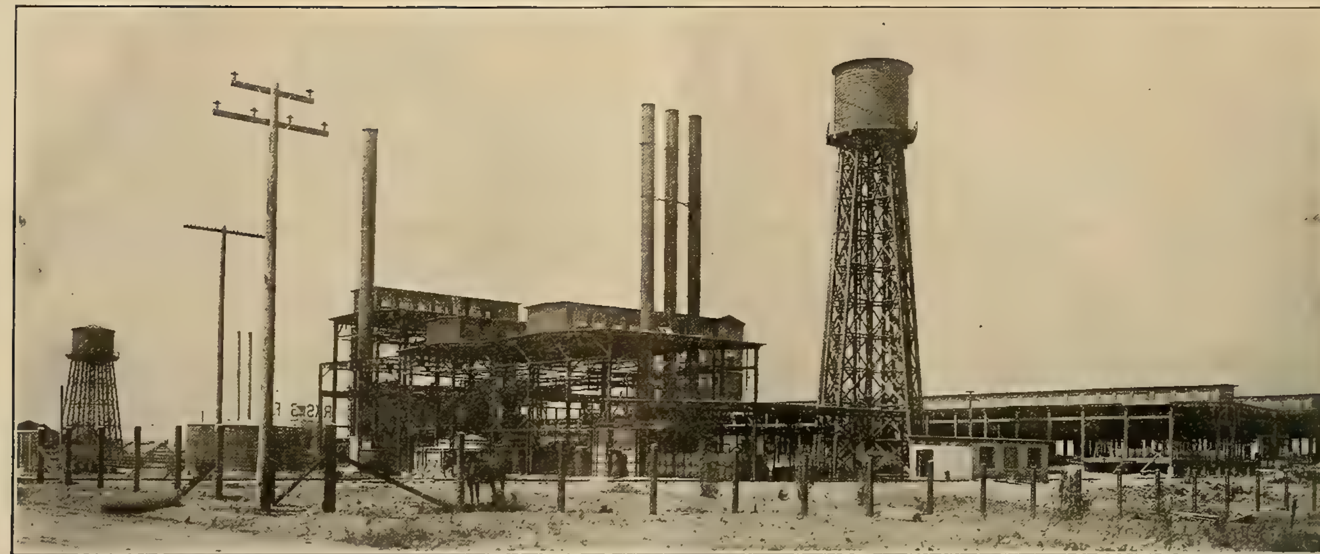
As the population has grown the interests on the Pacific Coast have never been completely diverted from gold mining, but new interests have been developed, more or less dependent on the stimulus due to the gold mines. It is only within a comparatively short space of time that industries completely independent of the gold mining industries have begun to spring forth.

Such are the chemical industries and other activities which derive their raw materials either from the baser minerals prevalent in the ground, or the timbers covering the slopes of the Sierras.

The abundant snow fall, on the high levels in the Sierra mountains, has always been a producer of great quantities of water, which the early miners used in their hydraulicking the gold out of the old river channels. They little dreamt in those days that this water, seeking a lower level, could be harnessed and its forces transmitted through slender wires to different parts of the state, and there let loose again for the purpose of producing happiness and wealth to the dwellers of the country.

One of the most recent types of new commercial activities that has been developed in the United States, and developed at a stupendous rate, is the electrochemical industry. The electrochemical industry is dependent upon various raw materials in addition to an abundant permanent cheap supply of electric power.

Niagara Falls, New York, has long been considered a Mecca for the electrochemical industries of the world, due to the enormous power developments there.



The Great Western Electro-Chemical Company at Pittsburg, California.

It has only been in the last few years that the Pacific Coast has even dared to think the thought of electrochemical possibility and it is only in the last year that electrochemical industries have actually been operating on the Pacific Coast.

Progressive financiers, together with the Great Western Power Company saw the possibility of establishing electrochemical industries on the Pacific Coast and organized a company known as the Great Western Electrochemical Company, for the purpose of operating electrochemical plants and manufacturing electrochemical products.

The first installation made by this company was for the purpose of manufacturing caustic soda and bleaching powder, also known as chloride of lime. Caustic soda is one of the staple products in the world's market. It is used in the households, as well as in nearly every industry imaginable. The soap industry, which by its development acts as an indication as to a people's degree of civilization, needs caustic soda as one of its primary raw materials. Refining oil, the manufacture of rubber, the cotton mills—all of them need caustic soda for one purpose or the other.

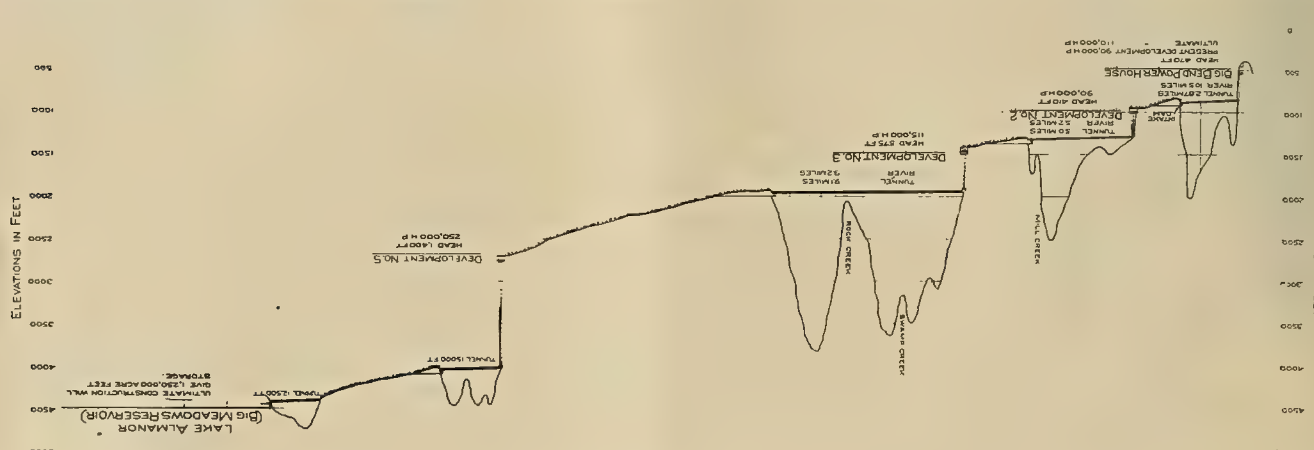
Bleaching powder on the other hand is used as a disinfectant in households for purifying drinking water supplies and also as a bleaching agent, as its name indicates, for paper mills, cotton mills and other industries. The chlorine content of the bleach can be liberated by chemical means and used for the purpose of chlorinating various materials, such as ores and chemicals, the bleach being a very convenient chlorine carrier.

The Pacific Coast with its growing industries furnishes the natural outlet for this first caustic soda and bleach plant in this locality, consuming in its various oil refineries, soap factories, etc., all the caustic soda produced and the growing paper pulp industry on the Pacific Coast takes care of the bleach output.

The total tonnage of finished products shipped out at present from the Great Western Electrochemical plant is 15,000 tons in a year.

The Great Western Electrochemical Company's plant is located at Pittsburg, California, and is the first plant in the United States of this type located on tide water, and the only one of any nature west of Detroit.

The raw materials which go into the manufacture of the caustic soda and bleach are common salt and burnt lime. The salt is produced in abundance at various points along the Pacific Coast and limestone from which the burnt lime is derived is obtainable



Profile of Present and Proposed Developments on the North Fork of the Feather River.

from a number of deposits in the Santa Cruz mountains, as well as in the Sierra Nevada Mountains.

The primary chemical reactions underlying the manufacture of caustic soda and bleaching powder, are extremely simple. The salt is submitted to the action of the direct current in suitable cells, by which sodium and chlorine are liberated. The sodium forming with the water present, caustic soda, and the chlorine, being a gas is carried off and is absorbed in suitable chambers by lime, forming the bleaching powder.

The following chemical formula indicates what takes place with the salt under the influence of the electric current:

$$NaCl + H_2O = NaOH + Cl + H.$$

The chlorine is absorbed in slacked lime as follows:

$$Ca(OH)_2 + 2\,Cl = CaOCl_2 + H_2O.$$

From this it is apparent that the electrcal energy which is used for the electrolytic production of these materials is in the nature of direct current. The Great Western Power Company furnishes alternating current to the chemical company. This energy is passed through five rotary converters, whose output is the direct current used in the electrolysis of the salt solution.

Each converter supplies current to a battery of cells. The cells are narrow chambers which are practically divided into two compartments separated from each other by a porous diaphragm. In one compartment an electrode of graphite dips down, which is the positive pole, and there the chlorine is liberated, while in the other compartment an iron electrode is placed which acts as negative pole where the caustic soda is obtained. There is a continuous flow of salt brine into the cells and an equally continuous flow of caustic soda admixed with some salt from the cells. The cells operate at a voltage of less than 5 volts and a number of cells are placed in series to take care of the voltage which the rotary converter delivers. The Allen-Moore cell is used exclusively and with success in this plant, as is the case in many installations in the east.

The salt brine which is admitted to the cells has to be practically chemically pure. This is accomplished by treating the salt solution with various chemicals and in such manner eliminate various impurities.

The caustic soda which is collected in troughs from the different cells is conveyed by pipes to a large storage tank, from which it is drawn off from time to tine into large vacuum concentrating pans. In these pans the salt is separated out from the caustic soda and finally a pure caustic soda liquor is obtained which in some cases is shipped out in tank cars, while in other cases it is permitted to flow into enormous big iron pots which are externally heated and where the caustic is finally liberated from all water and is obtained in a molten condition. In this shape the caustic is poured into the commercial steel drum in which it is shipped to all parts of the world.

The chlorine is conveyed by means of pipes to a series of chambers whose floors are covered by a layer of hydrated lime. After a specific number of hours of exposure the lime has absorbed chlorine to complete saturation and the product which is bleaching powder,

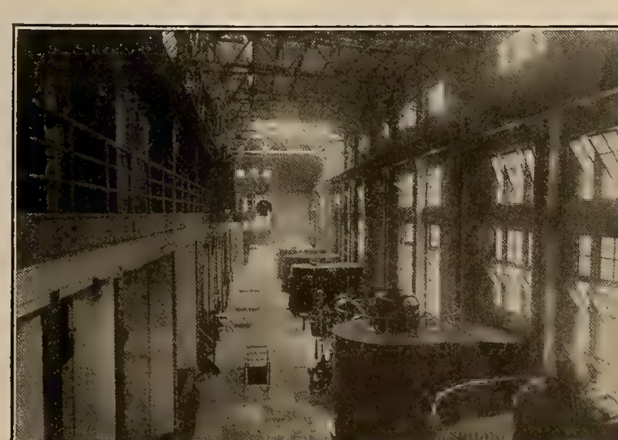
Storage Reservoir, Power House and Transmission System of the Great Western Power Company.

is shoveled out and placed in large steel drum containers, in which it is shipped to the consumers.

The hydrogen which is liberated as shown in the chemical formula, can be collected and used, but is as a rule permitted to escape into the air.

The Great Western Electrochemical Company's plant covers a considerable part of nine acres of ground, at Pittsburg. California. The buildings are of the very best construction. In the case of the cell and generator rooms, they are built of brick, while the building housing the bleach chambers is an open wooden structure and the evaporator house containing boilers, pots and the vacuum pans, is a steel structure. The necessary storehouse and machine shop are structures covered by asbestos corrugated steel.

In connection with operating a plant of this type, there is needed considerable amount of chemical skill.



Interior View of Las Plumas Power Plant.

To take care of the chemical end there is erected a laboratory divided into two parts. One is the so-called routine laboratory where the operating analyses are carried out, while the other part is the research laboratory in which any problems in connection with the operation, or future developments, are carefully studied.

The suitable administration building near the entrance gate, furnishes headquarters for the office and engineering force.

The Great Western Electrochemical Company is capitalized at two and one-half millions and its first installation has cost about six hundred thousand dollars.

The plant has been in operation for the last five months and has turned out goods of the same standard as those that are made by the eastern manufacturers. The company is in active charge of Mr. John F. Bush, formerly closely associated with some of the industries of similar type in the east. The firm of Bush, Beach & Gent, chemical brokers of New York and San Francisco, market the complete output from this plant.

RECLAIMING OF ALKALI LANDS BY ELECTRICAL PUMPS.

Electricity is playing an ever widening role of activity in reclaiming apparently useless lands in the West. First came the electric pump to irrigate arid lands. Then followed the electric pump to drain submerged lands and later irrigate them at proper intervals. Now comes the successful reclamation of alkali lands by electrical means.

Evidence that worthless alkali land can be restored to fertility by washing down the alkali through flooding, and preventing recurrence of alkali trouble by drainage and electric pumping, is given by the University of California in a "Preliminary Report on Kearney Vineyard Experimental Drain," just published by the University of California and obtainable free by writing to the College of Agriculture at Berkeley.

To remove the alkali, all of the land was flooded for a week to a depth of six to twelve inches. The water was then removed, through the drainage system and by working an electric pump. As much as forty acres were under water at one time, so that the alkali should be carried downward rather than washed out laterally. The land was flooded in a similar way the following year. The water table has been kept low by pumping. The result is that flooding in two successive years and drainage has reduced the alkali to an amount considered safe for crops. After three years, the tract, previously worthless, this year produced a crop of 180 tons of grain hay, and the land is believed to be in such a condition that alfalfa can be successfully grown in 1917.

The work was, however, expensive. The cost was approximately $100 an acre. This cost was largely due, however, to the fact that the work was experimental in character. It is believed by the College of Agriculture that with the next piece of alkali land on which similar reclamation work is undertaken by the University that it will be possible to bring the cost within sixty dollars an acre.

THE USE OF NATIONAL FORESTS FOR WATERPOWER DEVELOPMENT.

In the fiscal year 1916, says Henry S. Graves, Chief of the Forest Service, in his annual report, 20 new waterpower projects which utilize National Forest land began operation. This was an increase of 18½ per cent in the total number. In the fiscal year 1915 the number of new projects which began operation was 12. Forty-two per cent of the total developed waterpower of the United States utilize National Forest land, the Forest Service figures show.

Development of relatively small projects is particularly in evidence, according to Mr. Graves, in the Rocky Mountain states. California leads in the amount of power under permit and in operation. The number of transmission line permits in effect was increased by 13 during the year. The 40 applications for power-project permits received in 1916 included 8 from Alaska—a notable evidence, according to the report, of increased local interest in power development on National Forest lands there.

Concerning the report prepared by the Forest Service in response to a resolution of the Senate calling upon the Secretary of Agriculture for information regarding the ownership and control of waterpower sites and any facts bearing on the question as to the existence of a monopoly in the ownership and control of hydroelectric power in the United States, Mr. Graves says: "This report presented in far greater detail than has ever been attempted before an exhaustive analysis of the general power situation. It showed a marked concentration of definite and complete control of a large percentage of developed waterpower by a very few companies. Data presented regarding interrelationships through common directors and principal officers indicated a marked tendency toward association or community of interests, particularly between the principal holding companies. The movement toward concentration in commercial central stations of all the primary power employed in the electrical industries and in manufactures was found in all sections of the United States, the rate of concentration during the period 1902-1912 being highest in the South Atlantic States and the extent of concentration greatest in the Western States.

The rate of increase in waterpower development for public service use from 1902-1912 was approximately three times as great as in steam power. Primary power installation from all sources and for all uses increased from 1902 to 1912 more than 2½ times as rapidly in the eleven Western States as in the remainder of the United States, while the increase for primary electric power for the same period was 440 per cent for the Western States, as against 226 per cent in the other states. The development per capita of the Western States in 1912 and 2½ times as great as in other parts of the country.

The report showed a considerable over-development in nearly all the power centers of the Western States—California, Oregon and Washington in particular showing installations far in excess of maximum demands.

A BUREAU OF GOVERNMENTAL RESEARCH

BY BRUCE CORNWALL.

(Here is an account of an incorporated non-partisan citizens' agency formed for the purpose of studying public business, for co-operating with officials and especially for promoting economy and efficiency in municipal affairs. In view of the millions of dollars being invested in public engineering enterprises of the West, this article, by the chairman of the Board of Trustees of the San Francisco Bureau of Governmental Research, should prove exceptionally timely.—The Editor.)

San Francisco men and women after the fire of 1906 rebuilt their city principally in steel, reinforced concrete and brick, spending thereon more than $325,000,000, and yet, after it was done, of the eleven principal cities of the United States, San Francisco had the lowest percentage of mortgage debt on real estate—only 18 per cent of the value of real estate and improvements. In every line of activity there has been a remarkable growth, notably in savings bank deposits, commercial and national bank deposits and resources, bank clearings, postal receipts, import and export shipping tonnage movement arrivals almost beyond belief. But—

One significant fact which stands against this proud record is this: In the past fifteen years San Francisco's population has increased about 46 per cent, while her municipal expenditures have increased 165 per cent.

Realization of this fact led to the appointment of the San Francisco Tax Committee and the employment of the Bureau of Municipal Research of New York to make a survey of the city governmet. The survey has been made.

On the 19th day of October, 1916, there was incorporated the San Francisco Bureau of Governmental Research, to follow up the recommendations of the survey. The taxpayers of San Francisco, interested in accomplishing the work thus undertaken, have guaranteed the bureau $100,000 to follow up the survey report. The Bureau of Research will begin its active work on January 1st.

The people want San Francisco to begin now to operate its business economically and efficiently, and not to wait, as did New York City, until forced to act by threatened bankruptcy. The San Francisco municipal bonded debt has increased year by year from a debt of $4,296,600 in 1907, to a debt of $44,720,700 in 1916. The annual interest paid on this bonded debt has increased from $152,524 in 1907, to $2,101,317 in 1916.

Under similar but more aggravated circumstances in New York a few years ago, recourse was had to a similar remedy, and this year in his speech to a committee at the Hotel Astor, Mayor Mitchell was enabled to say:

> "By most careful budget making and use of appropriations, the administrative cost of the government has been cut $3,125,000. . . . Notwithstanding this reduction, great extensions in service have been made. The record is clear on this point for any one to read."

We are going to try to make it possible for a mayor of San Francisco to truthfully make a similar statement in San Francisco some time within the next few years.

A great majority of citizens and officials actually want efficiency, economy and honesty in public affairs, and actually resent waste, incompetency and dishonesty. However, many citizens, after long years of suffering, have come to have a firm, fatalistic belief that municipal government must be less competent and less honest than private business.

It is the purpose of the San Francisco Bureau of Governmental Research to largely disprove this fatalistic belief and to offer a way to improve, if not perfect, local government.

It is naturally asked, "How are you going to do this? What authority have you, a private organization, to make you think you can accomplish anything with public officials?" A private bureau of research has no authority behind it to enforce its principals, save and except the authority of public opinion. But what better authority is there anywhere than determined public opinion? And in what work has the public a more general or deeper interest than in this?

First, consider the effect taxation has upon the general business of a community, not only as a burden imposed upon citizens which prevents the use of income for other purposes, but also the effect it has as an anticipated burden upon individuals and associations of individuals considering the adoption of the city as a home.

In the neighborhood of San Francisco and tributary to the bay, there are many cities and towns within which a new industry or enterprise may contemplate making its home. In deciding which of these cities to locate in, the subject of the rate of taxation is a prime consideration. It is to the interest of every one in San Francisco, therefore, to keep the rate of taxation down as low as possible consistent with good service, in order to attract to San Francisco new people and new enterprises.

Second, we live in a time when government is extending. The principle that was taught a few years ago as the fundamental principle of government—that the least governed people is the best governed people—is no longer generally accepted as true. Society today demands more from government and every year additional functions of government are adopted. The cost of government is increased necessarily with the adoption of each new function. While formerly we could worry along well enough with a simple system subject to political abuse, it has, under the new order, become necessary that government be efficient and that the old haphazard and extravagant customs be set aside. It is of material and considerable interest to every citizen, therefore, that the machinery of government be made as perfect as possible in order that the expense of all of the activities of government may be borne without individual suffering or community disaster.

Now the present situation in the first eleven cities by population of the United States is this:

The cost for government to each individual city in the year 1915 was as follows:

New York	$45.85
Chicago	33.97
Philadelphia	28.67
St. Louis	31.32
Boston	49.29
Cleveland	41.20
Baltimore	39.83
Pittsburgh	39.89
Detroit	38.44
Buffalo	38.61
San Francisco	53.88

and the average cost throughout the United States was $30.17.

These figures, given by the United States Census Bureau, are authentic, and it does not seem necessary to go further to find the reason why we in San Francisco should become busy in putting our house in order.

How Are We Going to Go About This Task?

Briefly, we are first going to maintain a careful, daily watch for ourselves throughout the city government. In this, of course, we are greatly assisted by the very excellent survey already made by the New York Bureau of Municipal Research. No official will suffer from any publicity from the Bureau of Research unless he denies provable facts, exhibits deplorable incompetence, or tries to confuse the public mind with respect to the significance of defects noted.

We hope and we aim to keep the public activities of the bureau impersonal; to keep out of politics, and to work with the elected officials, whoever they may be, looking out as the citizens' agent for the citizens' interests each day in the year.

We expect to accomplish this: Increased and better service at less cost; one dollar's worth of service for $1.00 of taxes paid. We expect to improve the efficiency in the handling of public business so that the cost of operation will be cut sufficiently to save funds for additional requirements.

We intend to study the city's debt and to make it a matter of plain understanding to all voting citizens. We will inquire into the waste of bonded debt and consider the proposition of the pay-as-you-go policy. As an instance of what is meant, let us consider our present school bonds.

Of these there have been issued since 1904, $7,216,400. When these bonds are retired, in addition to the payment of more than seven millions of dollars, the taxpayers of the city will have paid $4,255,592.79 for the use of the money. It is now generally believed that this is bad municipal business. It is urged that non-income-producing, permanent improvements should be paid for in the actual tax budgets. While it may temporarily mean a somewhat heavier burden, it will ultimately result in a reduction in the budget and be an economic saving, and in dollars and cents it will cost the taxpayers 50 per cent less than the old, long-term bond policy.

We are going to try to improve the city's budget making; try to standardize supplies and salaries; try to do away with useless and superfluous positions. In other words, we are going to try to get an intelligent consideration of the 703 specific recommendations for improved, efficient government contained in the survey report, and also of such other recommendations as our local bureau may make after careful investigation and study. We are going to try to have the good recommendations adopted.

A word about cost. The survey cost $8197.61. As an offset, take a single instance of saving effected. Voluntarily, the Board of Fire Commissioners, through their secretary, notified us that they had abolished certain unnecessary positions and apparatus recommended for abolishment in the Fire Department, thus effecting an annual saving of $23,055.63. In itself this one saving covered much more than twice the cost of the survey and resulted in the transfer of about $15,000 from salaries fund to pay a part of the cost of motorization.

It is estimated that the cost of maintaining the bureau efficiently will be $20,000 per year. The citizens of San Francisco have already assured the bureau that income for the next five years. It seems to be a very moderate cost. One of the trustees of the Crocker Bank has mentioned that it cost $10,000 a year to audit that one bank, and $20,000 seemed a small amount for the City of San Francisco.

I believe that we will more than save to the City of San Francisco this annual cost every month that the bureau operates.

Finally, let me say, that this whole work may be summed up in the words—municipal thrift. The time has come when San Francisco, to go ahead in successful competition with the other cities of the world, must become thrifty in its public business. Help along this work by letting it be understood that you are behind it asd strongly for it.

THE BIENNIAL REPORT OF CITY LIGHTING AT SEATTLE.

In a recently published booklet of eighty-six pages entitled "City Light," which contains the biennial report of the lighting department of Seattle, Wash., the following interesting statement of expense and revenue for the six months ending June 30, 1916, is to be found:

This statement is made subject to adjustments at the end of the fiscal year, December 31, 1916.

Revenues.		
Business	$155,681.38	
Residence	236,452.10	
Power, alternating current	69,995.46	
Domestic power	5,976.60	
Power, direct current	7,415.45	
Power, direct current, street railway	6,572.44	
Street lighting	119,220.86	
Gross operating revenue		$601,314.29
Expenses.		
Operating and maintenance	$229,885.83	
Operating and interest, bonds	49,512.50	
Gross operating expenses		279,398.33
Net operating revenues		$321,915.96
Depreciation		114,155.82
Surplus, devoted to Redemption of bonds, payment of construction interest and to construction		$207,760.14
Vouchered in favor of general fund for construction interest	$33,750.00	
Vouchered in favor of sinking fund	29,700.00	
Vouchered in favor of redemption fund	10,500.00	
		73,950.00
Net surplus for construction		$133,810.14

TRADE RELATIONS WITH JAPAN

BY JIUJI G. KASAI, A. M.

(This excellent paper deals with the very delicate situation of friendly commercial and engineering relations between Japan and the United States. The arguments presented deal in sound facts and should immeasurably forward the traditions of peace that have so long bound the two nations together. The paper as a whole was delivered before a recent meeting of the San Francisco Electrical Development & Jovian League at the Palace Hotel.—The Editor.)

Transportation Methods in Japan.

DURING my long residence in your country, as a student of American institutions, I have travelled from the Pacific to the Atlantic, and having seen your wonderful land with vast resources, I have come to my firm convictions that the invincible spirit of the American people has made America the foremost among the nations. I have gone to Mt. Vernon to pay my own and my countrymen's homage to the memory of the "Father of His Country"; I have visited Valley Forge to remember the heroic deeds of the valiant soldiers of the American Revolution; again I have journeyed to New England to pay my veneration to those gallant minute men who embattled at Bunker Hill and who sacrificed their lives at Lexington and Concord.

When I think back the history of the wonderful growth of your nation in its westward course from the time of the Revolution, I am filled with wonder and admiration. Today this wonderful United States has her territories stretched to the Pacific Ocean and her dominion extended across the seas. Today the international relations between the United States and Japan have become much closer than in the past, and our two nations are going to play their important roles upon the stage of the twentieth century. As a student of international affairs with his ardent desire for the maintenance of the friendly relations between the United States and Japan, I wish to speak candidly and without reserve just as I would to my intimate friends.

Sixty-three years ago your gallant Commodore Perry awakened the secluded Empire of the Rising Sun with the booming of cannon and introduced her to the nations of the West. From that time on, the United States befriended Japan against the perils of foreign aggression, and Japan in turn has revered America as her teacher and true friend. In reviewing the romantic history of the international intercourse, between Japan and the United States, it is especially interesting for those of us in California to recall President Fillmore's message to the Emperor of Japan. The message read in part:

"Our State of California, produces about sixty millions of dollars in gold every year, besides silver, quicksilver, precious stones, and many other valuable articles. . . . . I am desirous that our two countries should trade with each other. . . . I have directed Commodore Perry to mention another thing to your Imperial Majesty. Many of our ships pass every year from California to China; and great numbers of our people pursue the whale fishery near the shores of Japan. It sometimes happens, in stormy weather, that one of our ships is wrecked on your Imperial Majesty's shores. In all such cases we ask, and expect, that our unfortunate people should be treated with kindness, and that their property should be protected, till we can send a vessel and bring them away. We are very much in earnest in this."

Thus, the growing commerce and industry of California led the government of the United States to force open the doors of the Japanese Empire.

California Hostile but Japan Amicable.

When a decade ago Japan fought in the titanic struggle against Russia, the American people gave us hearty sympathy and moral support. But hardly had we fulfilled the hopes and expectations of the liberty-loving American people when suddenly there appeared fears and suspicion of Japan in this country. California, for whose prosperity and commercial interest the sealed gates of Japan were opened, now turned to be a provacateur to threaten the historic friendship of of our two countries which had existed for the last half century. When, in 1907, our friendly relations were disturbed by the San Francisco school question, Japan tried her utmost to preserve the amicable relations with the United States. In order to avoid any future complications the Japanese government entered with the government at Washington into the "gentleman's agreement." Since then the Japanese government has been stringently observing the agreement, and has strictly forbidden emigration to this country. During the last eight years, Japanese immigration into the United States practically ceased, while many Japanese returned home from America. Consequently, the Japanese population in the United States has decreased in considerable numbers. Therefore, the so-called "Japanese menace" has remained merely as a bogey of alarmists, agitators and yellow journalists Since then the whole Japanese nation has been in earnest for the maintenance of the amicable relations with your country. The passage of anti-alien land legislation in California in 1913, therefore, caused a mingled feeling of indignation and disappointment of the Japanese people as well as among American friends of justice and righteousness. But, the Japanese people have preserved their characteristic patience and forbearance and trusted in the wisdom and sense of justice of the American people, firmly believing that you would give them a more humane treatment in the future. We are hoping that you will come to understand our true aims and aspirations as a nation, and

will realize the contributions made by Japanese farmers in California to the American life by converting arid lands into prosperous vineyards and turning marshes of the Sacramento and San Joaquin rivers into fertile lands for potatoes and vegetables.

Japan is Peaceful and Respects America's Monroe Doctrine.

Japan has never entertained the idea of American invasion as has been imagined by alarmists in this country. On the contrary, she is ever peaceful and friendly toward the United States. She respects the Monroe Doctrine,—the guiding principle of your foreign policy. She has never entertained any territorial ambition in the Western hemisphere. Her dominant desire is to see a strong China, capable of maintaining her own independence and sovereignty, which will naturally result in the peace and security of the Orient.

American-Japanese Trade is the Strongest Bond of Friendship Between the Two Nations.

Many of Japan's detractors view the rise of Japan as a menace to the American interests in the Orient. But, instead of being your "dangerous competitor," Japan has proved herself to be a boon of American commercial prosperity in the Far East.

The Japanese Parliament Building at Tokyo, where Friendly Foreign Relationships are Evolved.

Since Japan became a world power your Oriental trade has been constantly increasing, and our mutual commercial ties are being strengthened every year. The greater Japanese industries grow the greater will be the American commerce with Japan. In 1886, the trade between Japan and the United States, amounted to less than $10,000,000, while today it has reached to $150,000,000. The growth of the American-Japanese commerce has been very rapid in recent years. According to the Annual Report of Commerce and Navigation of the United States, in 1915 your imports from Japan amounted to $98,882,638, while your exports to Japan reached $41,517,780. Thus the total foreign trade of the United States with Japan in 1915 amounted to $140,500,418. Furthermore, due to the European war, the Japanese-American trade increased tremendously in the fiscal year of 1916, and imports from Japan amounted to $147,644,228. (The total figure of American exports to Japan in 1916 is still unknown). The United States has imported from Japan the articles which have been indispensable to her industries while she has exported to Japan those which the latter country has needed for her industrial expansion. The principal articles of the American-Japanese trade in 1916 are as follows:

Imports to U. S. from Japan.	
Raw silk	$88,057,600
Silk goods	6,100,536
Tea	8,975,993
Bean oil	3,749,580
Copper	3,087,692
China wares	1,268,651

Imports to Japan from U. S.	
Cotton	$31,951,722
Kerosene	2,502,360
Steel plates	2,769,173
Tin	2,315,506

The United States imposes a very high tariff upon manufactured silks, while she allows raw silk to come in free to be turned into fabrics in American mills in Patterson, N. J., or in other textile centers in the East. As a result of the present war Japanese manufacturers who had hitherto bought machineries from Germany, England and France, commenced to buy from the United States, and the American exports to Japan is expected to grow in the future.

While American-Japanese Trade Grows, American-Chinese Trade Decreases.

While the American-Japanese trade has been growing in wonderful rapidity as has been described above, the American-Chinese trade has been rather declining. In 1911, the American imports from China amounted to $34,227,503, which rose to $40,156,139 in 1915; while the American exports to China which amounted to $19,287,836 in 1911, decreased to $16,402,475 in 1915. Thus, the value of American-Chinese trade of 1915 was $56,558,614, which is about one-third of the American-Japanese trade of the same year.

Charges that Japan Tries to Throttle the American Commerce in the Orient Are Absolutely False.

It has been charged that Japan has been trying to throttle the American commerce in the Orient. But, statistics speak eloquently that wherever Japanese influence extended, there American trade prospers. This is clearly shown in Chosen (Korea). Before the advent of Japanese administration in Chosen, American trade with the Hermit Kingdom amounted to almost next to nothing. In 1903, the American exports to Korea amounted to $199,188, but in the following year, when Japan took hold of the rein of government of the kingdom, it immediately jumped to $906,058. Since then American exports to Chosen have been increasng gradually while imports decreased almost to nothing. Thus, in 1915 American exports to Chosen amounted to $1,188,444, while imports amounted to only $8753.

The similar increase has been found in the American trade in Manchuria. Yet, charges have been made frequently that the Japanese government tried to defeat the American commerce in Manchuria by means of unfair rate regulations against American shippers. But, the Japanese government has never shown special favors to its nationals as against the interests of foreign shippers. If American cotton sheetings have been driven out of the Manchurian market, it was solely due to the competition of Japanese spinners who won over American manufacturers with their better banking and trading facilities, and more accurate knowledge of the needs, customs and language of their customers than their American competitors. In this connection, we must remember that although American cotton manufacturers of Lowell, Lynn and Lawrence might have lost their trade in Manchuria, yet

American cotton growers in Texas, Louisiana, Mississippi and Alabama and other Southern States have found the increasingly profitable market in Japan for their cotton crop. Moreover, when in 1909 the Japanese Honorary Commercial Commission visited the United States, Baron Shibusawa and other leading members of the party advised their California friends to plant sea-island cotton in the Imperial Valley, so that Japanese cotton mills would buy the entire crop. Today, the cotton growers of your Imperial Valley have found a very profitable market in Japan for their crops.

Trade.

It has been charged that the Japanese merchant marine is a menace to the American commerce on the Pacific Ocean. On the contrary, it has been a great blessing to American merchants and shippers. When a few months ago the scarcity of bottoms was felt on the Pacific, American shippers could not secure space for their cargoes even at $40 per ton, and their freights were piled up in Seattle and San Francisco awaiting for shipment. It was the Japanese merchant marine—regular liners and tramps—which made possible to relieve this congestion, and carried American manufactures to the Orient and Asiatic Russia at lower rates than were prevailing at the time.

Again, it has been charged that the competition of big Japanese firms has been a menace to American foreign trade. On the contrary, many Japanese firms with good banking facilities and branches abroad, are facilitating America's foreign trade. The best example can be found in the Mitsui & Company, Ltd,—one of the largest mercantile houses in the world. While the company, with its branch offices in San Francisco, Portland, Seattle and New York, is engaged in importing merchandise from the Orient, at the same time it is seeking to find markets abroad for American products. A few concrete examples suffice to illustrate this point. The San Francisco branch of Mitsui & Co. ships California products, such as grains, lumber, fruits, not only to Japan but also to Latin America and Europe, with its own steamers. Thus, though a Japanese company in name, yet it is serving American foreign trade just as faithfully and efficiently as American concerns can.

The Steamship China—A Well-known Transpacific Medium of Commercial Relations.

Electrical Industries in Japan.

I have thus far discussed the trade relations between the United States and Japan. Now let me tell you briefly about the electrical industries of Japan in which you might have your special and professional interest. In the last few years wonderful strides have been made in electrical enterprises in Japan. Since Japan is a mountainous country with an abundant supply of waterpower that can be adequately harnessed, she is destined to be a great industrial nation. According to a statement issued by the Department of Communication, July, 1916, there were 637 electrical enterprises in the Empire with a combined capital of $306,278,711. Of those, 16 were new plants built within the last year, with a total capital of $1,464,308. Of the total number of electrical concerns above mentioned, 550 are power-suppliers with a combined capital of $150,003,177, 42 are electric railway concerns with a total capital of $15,947,500, while the remaining 46 concerns are doing two sorts of business combined with a total capital of $140,328,035. Besides these, the Tokyo Electric Light Company recently decided to construct a new plant on the Chickumagawa River at the cost of $7,500,000.

The Partnership of Japanese and American Companies is Successful and Desirable.

In this connection it may not be amiss to tell you of the very intimate relationship that has existed between the electrical industries of Japan and of the United States. Again, mention may be made of Mitsui & Company. Many years ago, the company became the sole agent of General Electric Company in the Orient, and introduced into Japan everything made by the American concern. At the same time, electrical manufactures were introduced into Japan from England, Germany and France. But, the enterprise of Mitsui & Company gradually won for the American company its commercial supremacy in Japan. Meanwhile, there grew a native electrical company named the Shibaura Engineering Works, and its competition was began to be felt by the General Electric Company. At this moment, through the mediation of Mitsui & Company, the merger was completed between the Shibaura Engineering Works and General Electric Company. Today, the Shibaura Engineering Works are conducted by the joint supervision of the American and Japanese engineers, and profits are shared by the American and Japanese shareholders. Now, there appeared in Japan a rival company of Mitsui & Company in Takata & Company, representing the Westinghouse Electric & Manufacturing Company. Thus, we find that the electrical world of Japan is divided into two American camps, namely the General Electric Company and the Westinghouse Electric & Manufacturing Company. Then again, there is the Nippon Denki Kaisha (Japan Electric Co.), of Tokio, with which the Western Electric Company has formed a partnership. I understand that the Western Electric Company is still supplying telephone apparatus for Japan, and shares profits with the Japanese company. Today, due to the European war, the imports of the electrical machines and motors from England, Germany and France

have practically ceased, and the American electrical concerns hold their supremacy in Japan.

The success of these two American concerns in Japan has been largely due to the ability of their Japanese agents and partners, and it bespeaks so eloquently the integrity and trustworthiness of Japanese businessmen. Such instances as these put to shame those mischievous myth-makers who are continuously spreading ridiculous lies that the Japanese are so dishonest that they cannot trust even their own countrymen, and consequently employ Chinese cashiers in Japanese banks, and that Chinese merchants are more honest and reliable than Japanese, etc.

The Commercial Interdependence of the United States and Japan Should Serve to Prevent War.

Before concluding, let me repeat again that the commercial relations of our two countries which have been growing in intimacy should serve to strengthen the bond of friendship between the two peoples. Our commercial interdependence should be a sufficient guarantee against war. Take for instance an average citizen of Japan. He rises in the morning from his bed covered with sheets made of American cotton from Texas; he eats fruits from California and meat from packing houses of San Francisco or Chicago. His home is built with lumber from Washington and Oregon, and at night, his home is lighted with kerosene from California or Pennsylvania, and electric lamps from Schenectady or Pittsburgh. Our industrial plants are equipped with American motors and engines, and our railways are built with steel rails from South Chicago or Pittsburgh on which Baldwin engines draw Pullman cars. On the other hand, the United States is the biggest customer of Japan. Eighty per cent of silk and sixty per cent of tea imported by your country comes from Japan. Thus, your wives and daughters decorate your homes with Japanese art, and they dress themselves with the silk spun by the nimble fingers of Japanese girls; they entertain their friends with the tea picked upon the green hillsides of my native Japan; and your children are blessed by Santa Claus with dolls and toys made in Nippon. Fine and delicate is the thread of silk, yet it binds our two great nations.

Last summer, when Judge Elbert H. Gary, president of the United States Steel Corporation visited Japan, he was loyally welcomed by captains of industry and high officials of the government and the people in general. He was given an enthusiastic ovation wherever he went in Japan, because he is an influential American citizen. In the banquet given in his honor by our leading financiers and statesmen at the Imperial Hotel, Tokio, on September 5, Judge Gary said in part:

"I am here to say to you and to all your friends throughout Japan with all the emphasis that words can express, that the business men of the United States, with whom I am in close and intimate contact, do not look for trouble between the United States and Japan, now or hereafter. They would stubbornly oppose any suggestion of conflict between those great nations with all the force and influence in their command; and this is undoubtedly the prevailing and controlling sentiment of the citizens generally throughout the United States."

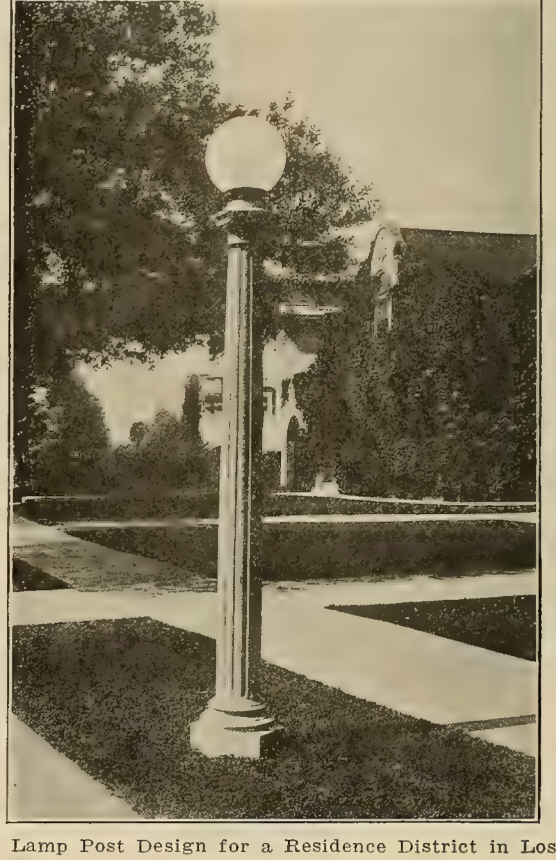
This frank statement of Judge Gary eloquently expressed the sentiment in the innermost hearts of the sixty million of my countrymen toward you, the American people. I sincerely hope that he has given expression to your controlling sentiment towards Japan. Thus may our two peoples grow in mutual understanding and respect which alone can bring international peace and concord. Thus may our flags,—the glorious Stars and Stripes and the emblem of the Rising Sun,—be the joint guardians of peace on both shores of the Pacific Ocean.

RESIDENCE LIGHTING IN LOS ANGELES.

Typical of recent evolution in street lighting, the beautiful Wilshire Boulevard, in the residence district of Los Angeles, is being adorned with the single lamp

The Wilshire Boulevard in Los Angeles.

standards of the type illustrated. The lamps constitute striking evidence of the growth of the artistic spirit in street lighting.



Lamp Post Design for a Residence District in Los Angeles.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING.

(The data published in this department should be of great value to all interested in the important subject of utilization of electric power for irrigation pumping. A number of power companies and engineers of the West are co-operating with the author in the gathering of the very latest experimental material for its columns.—The Editor.)

Canal Erosion Increases the Seepage Loss.

The Seepage Loss from Field Ditches is High.

Long Furrows Give Excessive Percolation Loss.

REPLENISHMENT OF GROUND WATER FROM IRRIGATION.

The usual or natural source of ground water is the percolation of precipitation directly through the soil or from the seepage loss from stream beds. These may be artificially increased in amount by preparing the soil so that a larger portion of the precipitation will be absorbed or by spreading the stream flow over adjacent porous lands in order to increase the seepage.

There is another source of ground water which may be of much assistance in replenishing the supply for irrigation pumping. This is the deep percolation of a part of the water applied in irrigation. In many cases the amount of such deep percolaton of irrigation water has exceeded the capacity of the underground drainage and the water table has risen until the water logging of lower areas has resulted.

In the majority of areas irrigated from gravity supplies, pumping within the irrigated area is not usual, all the water used being secured from the gravity systems. In some cases, however, particularly in California, the supply available from direct diversion, becomes deficient during the later portion of the growing season and pumping to supplement the gravity supply may be practiced for some crops. Also within the area covered by the canals may be many farms which do not have rights to canal water but depend entirely on pumping. That the bringing in of canal water is a material benefit to the person depending on pumping is now recognized by the California Irrigation District law. In irrigation districts, lands within the district which have secured their entire supply by pumping from the ground water are required to pay district assessments for bond interest and principal which generally represent the construction cost. No assessments are levied against such lands for operation and maintenance of the canal system if the operation of the pumping plant is continued.

Part of the water diverted by a canal may reach the ground water either by direct seepage from the canal or by deep percolation of a portion of the water applied to the fields. Such waters after reaching the ground water may be carried off by the underground drainage or if too large an amount may raise the height of the ground water plane until sufficient area and pressure are secured to carry off the water that is being received. If such additions are too large in amount the ground water plane may reach the surface in the lower lands. As the water added to the ground water at different times of the year varies, the water plane will also fluctuate. Ground water is subject to the same laws of flow as other waters and is always found moving under the influence of the slope of its surface, the rate of its movement, however, being usually very small.

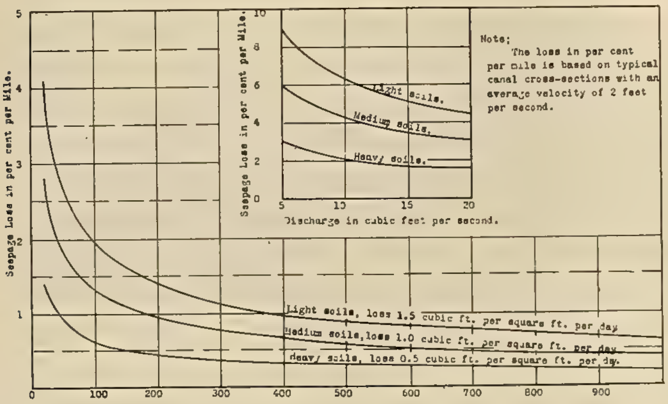
The seepage from earth canals depends mainly upon the character and extent of the wetted surface in the canal section. This may be either the original ground as excavated for the canal or as modified by deposit or erosion. Other factors which affect the rate of seepage are the temperature, velocity, form of cross-section and height of ground water in the adjacent soil.

Canal seepage can be expressed either in terms of percentage loss per mile of the total flow or as the loss in cubic feet per square foot of wetted area per 24 hours. Much data regarding measurements of canal seepage have been published in various bulletins and technical magazines. In general it has been found that the rate of seepage averages about 0.5 foot in depth per 24 hours over the wetted area for impervious soils, such as clays and clay loams, 1.0 ft. for medium soils such as the lighter silt loams or fine sandy loams and 1.5 ft. for pervious soils such as the coarser sandy loams and sands. For gravelly soils the rate may be much higher.

The loss in per cent per mile will vary with the size of the canal. The proportion of the wetted area to the capacity is much larger in small cross sections. By assuming typical forms of cross section and average velocities the rates of loss per square foot of wetted area can be expressed as per cent loss per mile. In the figure given herewith may be found a set of curves that show the per cent loss per mile for different rates of seepage where canal velocities are assumed

as 2 ft. per second. These curves show the rapid decrease in percentage loss with the increase in size of the canal.

In estimating the amount of water added to the ground water from canal seepage, the total loss in the canal system is a more useful unit; the total proportion of the water diverted which is lost by canal seepage may vary from 10 to 50 per cent. The average for all systems operated in 1914 by the United States



Average Seepage Losses in Canals in Per Cent Per Mile.

Reclamation Service was 35 per cent. As these were relatively new systems, not irrigating the full areas under the canals, the percentage losses will probably decrease with the development of the projects. In canal systems lined with concrete the loss may be very materially reduced. It is not usual, however, to line the laterals for large areas, authough there are a few locations where this has been done.

The seepage losses from the canal system may not all reach the ground water within the area covered. Where long diversion canals are used, the seepage in the upper system may return directly to the stream. The losses in the lateral systems go most directly to the local ground water. There are not as many records available where the loss in laterals has been kept separately from the losses in the main canals as for the losses in systems as a whole. The usual lateral systems will generally have a seepage loss of from 10 to 15 per cent of the water diverted into the system. This loss is usually a direct addition to the ground water within the area irrigated.

There is another source of loss in irrigation which usually exceeds the seepage loss in the laterals, and in some cases exceeds the seepage loss in the entire canal system. This is the percolation through the soil of a part of the water applied to the fields. Under careful handling of the water this loss can be made quite small. Under many types of irrigation practice such deep percolation losses are a large proportion of the water received. The loss is invisible to the irrigator, who consequently fails to realize its amount.

Moisture is present in soil in three forms. A certain amount of moisture is so intimately associated with the soil grains that it cannot be removed by plants or by drying in air. This moisture, known as hygroscopic moisture, is of no use to the plants. Moisture also occurs as a fine film surrounding the soil particles. This film is retained against the action of gravity and distributes itself from one soil grain to another by what is called capillary attraction. The movement of capillary moisture is from the more moist soil to that which is more dry. Such movement may be laterally or vertically. The third type of moisture is that subject to the action of gravity. This is the moisture in excess of the other two types which moves downward through the soil pores.

When the film of capillary moisture around the soil particles becomes so thin that the plants have difficulty in securing a sufficient supply for their growth, irrigation should be applied. This results in filling the pores in the surface soil in contact with the irrigation water and supplying it with gravity moisture. This gravity moisture moves downward through the soil. As it moves the capillary moisture of the soil with which it comes in contact is replenished. There is also some lateral movement of the capillary moisture beyond the area directly supplied with gravity moisture as in furrow irrigation.

The aim in irrigation should be to apply a sufficient depth of water so that the capillary moisture will be replenished to the depth of soil used by the plant roots without having any excess to pass below such depths. Capillary moisture tends to move in all directions until equalized, and some moisture may pass downward in a soil without its having any gravity or free moisture present. Any water passing below the depth of plant use becomes a deep percolation loss.

It is not possible to add just the right amount of water to each portion of a field so that no deep percolation will occur. The relative amount of water received by any unit of the area of a field depends on the length of time it is in contact with the water. In flooding or furrow methods of irrigation the area adjacent to the turnout or head of the furrow receives water for a longer time than the portions at the lower end. In order to be reasonably certain of giving sufficient moisture to those portions of the field which are hardest to reach, it is usually necessary to apply some excess to other portions. The more carefully the field is prepared and the water applied, the less will be the difference between the maximum and minimum amounts used.

Even with good practice some of the water applied will pass beyond reach of the plant roots if an attempt to moisten the full root depth is made. With careless preparation of the land or handling of the water, such deep percolation may amount to a very considerable proportion of the water received at the field.

The difference between the minimum moisture to which it is good practice to allow a soil to become dried and the maximum which it can retain against gravity represents the maximum amount which should be applied at any irrigation.

In order to estimate the amount of such deep percolation losses, a knowledge of the moisture holding capacity of soils under field conditions is necessary. The results of a number of investigations on different soil types are now available, and much additional work is being done by several of the experiment stations.

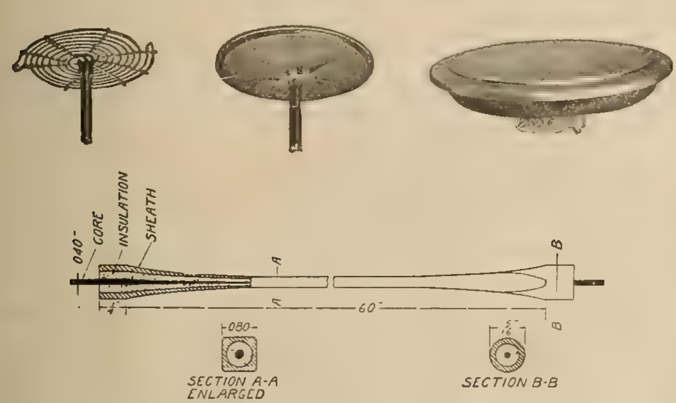
ELECTRIC COOKING AND HEATING

(Electric cooking and heating are the live issues of the electric power salesman. Education in modern electric appliances and their uses is the crying need of the hour. In this department the latest up-to-the-minute ideas along these lines will be published.—The Editor.)

TYPICAL ELECTRIC RANGE DESIGNS.

BY E. A. WILCOX.

Radiant Type Units.—These are usually coils of high resistance wire laid in grooves, or supported on the surface of insulating material. Current passing through this wire brings it to a high temperature, and the heat is transmitted for the most part as radiant heat direct to the utensil or the food to be cooked. Some of the heat, however, is absorbed by the insulating support and some is given off as convected heat both from the support and from the wire itself, the percentage varying with the design of the unit and its composition. In a well designed unit much of this convected heat is finally taken up by the food.



Process of Manufacture of General Electric Sheath Wire Heating Elements.

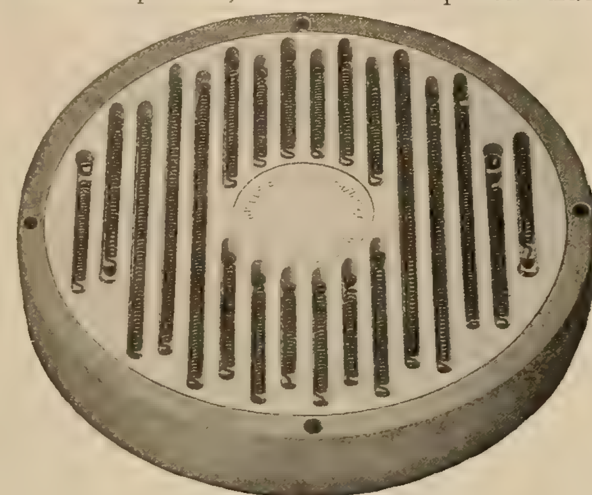
Radiant type units begin to throw off a large amount of heat almost as soon as the current is turned on. The heat in the coils, is visible on account of the high temperature. The nature of the radiant heat given off makes it possible to use the ordinary kitchen utensils to better advantage on the open than on the enclosed type elements. The coils being exposed, however, and the supports, as now manufactured, being somewhat brittle, this type of unit is to some extent liable to mechanical injury, short circuits, and grounds. It is also harder to keep clean than the enclosed type element.

Reflector Type Element.—Use is here made of the heat reflection principle. It usually consists of exposed coils of wire surrounded by air and supported adjacent to a bright metallic reflector. Part of the heat generated in the coils passes directly to the cooking utensil or to the food in the same manner as from the ordinary radiant type element. Another portion of the heat travels in the opposite direction until it reaches the polished surface, where it is reflected back on its course to the cooking utensil. A small percentage of the energy is, of course, given off as convected heat and some passes away through the reflector.

This type of element heats quickly, makes possible the use of most ordinary kitchen utensils, and produces a visible heat in the coils. It is, however, more subject to mechanical injury than the enclosed type element. The reflectors, although they can be easily and cheaply replaced, are also likely to become discolored and become inefficient on account of the intense heat. The future development of a cool reflector, however, may do away with the latter objection.

Types of Electric Ranges.

A large variety of electric ranges are manufactured in this country. They are available in many styles and capacities, and at various prices. Each of them has been developed with certain individual characteristics in design or operating features, having some advantages over those of other makes, but all of which could not possibly be incorporated in any single design. This chapter is therefore devoted to descriptions of the most prominent makes of electric ranges in order to convey a general understanding of the design, construction and individual characteristics of the types now available.



Hughes Open-Type Element.

Hughes Ranges.—This make of electric range has been on the market for a number of years. It is made in a large variety of shapes and sizes, in either the high oven, low oven, or cabinet types, and in capacities ranging from 4140 to 10,340 watts. The frame is constructed of black heavy gauge sheet metal supported on cast iron legs. The legs, top, and fittings are nickel finished in most of the designs. The general construction is rugged and of handsome appearance.

The heating elements are of the open or radiant type and consist of coils of resistance wire held in place below the cooking surface by means of a grooved composition block. This block is in turn, surrounded by another block of asbestos compound having high thermal resistance. The units may be easily removed with a screw driver and pliers.

The oven is thoroughly insulated with mineral wool. The interior of the oven is finished in black.

Thermometers are fitted in these doors. There are two heating elements in the oven—one in the top, and the other in the bottom. Each of these units is regulated by a three heat switch. The top unit is used for broiling. An enameled tray and rack for this purpose are provided with each range.

Hughes No. 50 Cabinet Range.

HUGHES RANGES.

Type. No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
C-2	Cabinet	2-880	18x12x12	1	1500	
				1	880	4140
C-3	Cabinet	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
C-4	Cabinet	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
C-18	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 27	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 30	Low oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 33	High oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 37	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
No. 40	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 44	High oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 47	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				1	880	5680
No. 48	Low oven	2-1100	18x18x12	1	1500	
				2	1100	
				3	880	8540
No. 50	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				2	880	6560
No. 56	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	1	1100	
		Warmer-	21¼x20x9	2	880	8360
No. 60	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	2	1100	
		Warmer-	21¼x20x9	3	880	10340

Simplex Ranges.—These ranges were first put on the market about nineteen years ago. The modern domestic types usually consist of an oven, a broiler, and several disc heaters. They are made up in either the low oven, or cabinet type, and in capacities ranging from 3100 to 8200 watts.

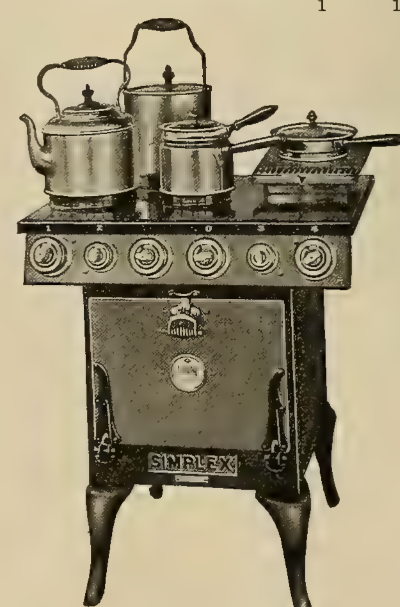
The heating units are of the enclosed type, the resistance wires being embedded in enamel, and fused to the under side of the cast iron discs. The discs protrude slightly above the top of the range, and are provided with a simple locking device by which the utensils are clamped fast to the heating surface to insure good contact. The units are fastened to the frame with thumb screws.

The broiler is mounted on the cooking surface. It consists of a corrugated heating plate slightly inclined toward the front, from which an outlet carries off the juices for serving with the meat. A separate smooth top fits on the broiler for making griddle cakes, etc.

The oven is made of Russia iron with japan finished iron frame and nickel plated trimmings. The walls are heavily insulated with corrugated asbestos and provided with a vent. The heating elements in both top and bottom are of the enclosed grid type, and are controlled by a single three-heat switch. The oven door is of the drop shelf type, fitted with an indicating thermometer.

SIMPLEX RANGES.

Type. No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
4K	Low oven	1300	15x12x11½	1	440	
				2	735	3210
5K	Low oven	1300	15x12x11½	1	440	
		1300	9x12 broiler	1	735	3775
6K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
7K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
8K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
9K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910
14K	Low oven	2400	21½x19x13	1	440	
		2200	12x18 broiler	1	735	
				1	1100	
				1	1300	8175
21K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	
		200	15x15x7 warmer			4715
22K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5010
23K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5450
24K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer	1	1100	6110
31K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
32K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
33K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
34K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910



Simplex No. 7-K Range.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(The electrical contractor and dealer are constantly running into perplexing problems of wiring installation, motor control and opertaion, window display, cost keeping and a thousand other hourly obstacles to business efficiency. This department is designed to meet just such needs. The author is apparatus specialist for the Western Electric Company.—The Editor.)

ALTERNATING CURRENT MOTOR TROUBLES

Low Voltage. Low voltage is probably the most frequent cause of motor trouble. This trouble may arise only during the starting period while the motor is drawing a heavy starting current or it may appear after the motor is started and is carrying its load. In this latter instance, if the voltage is considerably below normal the motor may not be able to carry its full load or will heat excessively.

Low voltage may be due to a number of causes. When referred to motors of five horsepower or less, which are usually started by being thrown directly across the line at full voltage, it invariably results from excessive line drop due to insufficient conductor capacity, that is, wires that are too small. Complaints of this kind are rather limited because these small motors are not generally required to start under heavy load and will run up to speed at a voltage considerably below normal. However, cases of excessive temperature rise are frequently traced to low voltage.

In connection with larger motors requiring a starting compensator, a wrong tap in the latter may not allow sufficient voltage at the motor terminals when the handle is thrown to the starting position. The motor may not start or it may start slowly but will not run up to speed. This depends on the starting torque required for the load. Some apparatus require the maximum torque at starting, with the torque falling off as the speed increases. The motor will then be likely to attain full speed if it starts at all. A good example is a line shaft with numerous hangers and driving pulleys.

On the other hand, some machinery—a blower fan for example—requires considerable more power as the speed increases. Thus, the motor may start but usually cannot attain more than a fraction of its normal speed. The remedy in such cases is simply in using the proper voltage tap.

Compensators are usually connected for the second lowest starting voltage and torque before shipment. If the motor will not start its load promptly with the compensator connected as received, the next higher voltage taps should be tried and so on until taps are found that will give the required torque. Should the motor not start wth the compensator arranged for the highest voltage, the remedy is to provide a larger motor or one that will develop larger torque. This may call for a phase-wound or slip-ring motor.

With these larger motors the trouble may also result from the heavy voltage drop in the supply circuit as already mentioned or may be caused by overloaded transformers. It is now almost universal practice to provide leads which have a normal carrying capacity 50 per cent greater than the full load amperes of the motor. In most cases this size of wire will be found ample provided the distance of transmission is not too great. With wires selected on this basis the limit of distance is about 590 ft. for 220 volt circuits or about 1075 ft. for 440 volt circuits. Up to these distances the voltage drop will not exceed 5 per cent, which is about the maximum to be recommended for such circuits. This is true for either two or three-phase circuits. Greater distances require larger sizes of wire to avoid excessive voltage drop and its attendant results.

In the isolated plant low voltage is sometimes the result of poor voltage regulation in the generator. By voltage regulation is meant the percentage rise in voltage between full load and no load. This percentage of regulation depends upon the design of the generator and nature of the load. It is particularly affected by loads of low power factor, such as induction motors.

The tendency of the present day is towards small motors and individual drive on account of its many advantages, so if care is not observed to properly fit each motor to its load there is likely to be a number of partially loaded motors producing a general load of low power factor. Should this resulting power factor be lower than that for which the generator has been designed and guaranteed it will be impossible to maintain normal voltage.

This, however, is not the only objectionable effect of low power factor. It will also produce increased losses and poor regulation in the lines, decreased generator capacity, increased heating, in fact, is responsible for a whole string of ill effects.

The remedy when such conditions exist is to rearrange the load so that each motor will operate at practically full load and further to avoid operating a number of motors idle or under light load. If this is not possible, then the only remaining remedy is to provide a machine to neutralize the inductive effect of the load. Such a machine is technically known as a synchronous condenser. Synchronous motors are also of value for this same purpose to a limited extent.

Again there may be certain applications demanding heavy starting torque and if the starting torque of the motor provided is at the best only sufficient to give the results, it is then very essential to keep the generator voltage up to normal. When the load is started frequently this requires much attention from the operator and a far more satisfactory method is to install an automatic voltage regulator. This device holds the voltage practically constant at all loads by control of the exciter voltage. This question of regulation has been covered quite in detail because it is not fully appreciated by many of our readers.

The general effect of the large starting current required by squirrel-cage induction motors upon the voltage regulation of an alternating current generator is outlined in the experience of a large manufacturing plant which had just been remodeled to use the individual motor drive. A number of motors ranging in sizes up to 75 h.p. had been installed. These were supplied with energy from a 325 k.v.a. 480 volt three-phase generator placed in the power house some several hundred feet away and connected to the plant by a transmission line operating at the generator voltage.

One of the motors, a 75 h.p. machine with squirrel-cage rotor was direct connected to a double band saw which, even under the most favorable conditions, required a very heavy torque at starting.

This machine had previously been operated from a long line shaft with the usual belt equipment and during the time the change was made to individual motor drive, the machine had been thoroughly overhauled. New bearings were supplied, also a new belt. On account of these changes the machine started much heavier than it would ordinarily do after having been in operation regularly for sometime.

When this equipment was tried for the first time there was trouble right away. The compensator was connected for the next to the highest voltage and when thrown to its starting position caused the motor to draw a heavy current. This immediately re-acted upon the generator causing its voltage to fall from 480 down to about 325. At this low voltage the motor would, of course, not start and in a few seconds the line fuses would blow.

This same performance was repeated several times not only with this particular motor but with several others driving different machines. The result was similar and finally the owner appealed to the manufacturer who supplied the equipment saying that there was something radically wrong.

A few more trials by the manufacturers representative soon pointed out the cause. The engineer at the power house had paid absolutely no attention to the generator and consequently the voltage fell very low during the time these large motors were started. The engineer at the power house was stationed at the switchboard and told just how to manipulate the field rheostat when the motors were thrown on as indicated by the switchboard ammeters. The voltage was by this means maintained at about normal and after several trials the large motor driving the saw was able to start its load within reasonable time. Later on, the belts were loosened, and as the bearings wore down a little the difficulty was not again experienced.

This trouble was entirely eliminated after installing an automatic voltage regulator which had been ordered with the generator but not received up to the time the experience just related happened.

The ordinary type of a squirrel-cage motor is not well adapted for starting loads of this kind and it would have been better practice to have provided a motor of the phase-wound type giving a much higher starting torque and at the same time drawing a smaller starting current.

This particular instance further illustrates the marked effect of starting a large motor from a generator of comparatively small capacity.

Motor Nameplate Incorrectly Marked.

Once in a great while a motor will be found with a nameplate incorrectly marked. If the motor is wound for a voltage higher than that indicated on the nameplate, the action at starting will be the same as due to any other cause of low voltage but more marked on account of the considerable difference between standard voltages for motors. For example, a motor wound for 220 volts but marked 110 volts, would be able to develop only ¼ of its maximum starting torque, even if started at full line voltage. Looking at it in another way, a 5 h.p. 220-volt motor on a 110-volt circuit would have operating characteristics similar to those of a motor ¼ its capacity or 1¼ h.p.

Conversely, the nameplate may be marked for a voltage higher than that for which the motor is designed. In this case the motor will draw a heavy starting current and the fuses will blow almost immediately after the starting switch is closed.

When started by means of a compensator, however, a motor so marked will probably not blow the fuses until the compensator handle is moved to its running position, giving full voltage across the motor terminals because with the handle in the starting position the voltage received from the compensator is considerably less than full voltage.

These errors in marking are not common but are often troublesome because they are difficult to check unless the winding specifications for the particular machine are available.

As an example of incorrect nameplate stamping at the factory, the following experience is of value. A squirrel-cage motor rated 20 h.p. at 440 volts was belted to a wood working machine, being controlled by the usual form of starting compensator with fuse panel for overload protection. The motor started promptly with the compensator lever in the starting position but when the lever was transferred to the running position, the fuses burned out immediately. The fuses were replaced and another trial made but with the same results.

The belt was then removed and the same performance followed with the motor running unloaded. The action was just the same, the fuses on the panel blowing out almost immediately upon placing the starting compensator lever in the running position.

The compensator was tested and found to be without defects. The taps on the various coils were in correct position and the voltages between leads with compensator lever both in running and starting positions were correct and equal across all phases. Inspection of the winding of the motor indicated it to be in good condition. Further tests proved this to be a 220 volt motor incorrectly marked for 440 volts. The motor was replaced by one with correct winding.

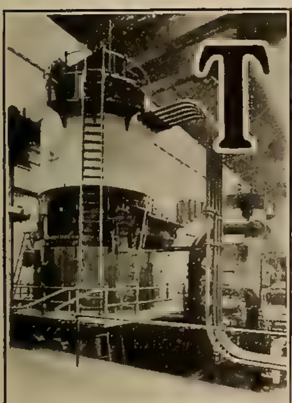
Some time later a similar experience came up in connection with an 18 in. ventilating fan of the direct connected type. The fan would not come up to speed and after several trials it was found to be a 220 volt motor on a 110 volt circuit, although the nameplate indicated it as being a 110 volt machine. In this case the winding was re-connected for the proper voltage.

FUEL OIL AND STEAM ENGINEERING

(Fuel oil and steam engineering are today receiving an immense impetus in the West. The new shipbuilding, combined with a normal activity in steam auxiliary design, call for up-to-date educative knowledge along these lines. This series is written so as to be devoid of higher mathematics. Readers of the Journal who desire to follow these articles as a course of study may do so by applying to the Extension Division of the University of California, where by the payment of a small fee, a series of questions and answers with problems illustrating the text may be acquired.—The Editor.)

THE MODERN POWER PLANT FOR FUEL OIL CONSUMPTION.

BY ROBERT SIBLEY.



A 20,000 h.p. Curtis Turbine Installed in San Francisco.

THE enormous growth of the electrical industry throughout the world during the past decade has entirely revolutionized methods of power development. Especially is this true west of the Rocky Mountains, where gigantic natural water powers have been put to a useful purpose. Owing to the fact, however, that most of the western streams show a great variation in flow in the different seasons of the year, it is not always possible to depend solely upon waterpower for the supply of electrical energy. In recent years the advent of crude petroleum upon the Pacific Coast, representing a total in production of over one hundred million barrels, has made it possible when rainfall or water supply is lacking to economically supply the needed power. During certain hours of the day, too, when the so-called peak load conditions are to be met by a central station, additional electrical energy over that possible to supply from the hydroelectric station is found to be necessary. Hence, the steam power plant, consisting of large concentrated units, is now recognized as an indispensable auxiliary to continuity of service.

In order that there should be no excessive loss in distribution, these concentrated steam power units are usually found in the heart of the great distribution centers. Especially is this true where abundance of circulating or cooling water may be obtained. Thus we find in Central California, Station A and Station C of the Pacific Gas & Electric Company, and the Fruitvale Station of the Southern Pacific Company, all situated in the distributing centers of San Francisco and its immediate vicinity. In Los Angeles we find that the Redondo Plant of the Pacific Light & Power Corporation and the Long Beach Plant of the Southern California Edison Company, owing to the lack of abundant cooling water near the distribution center are situated at a distance from it of some fifteen or twenty miles.

It will now be interesting and instructive to examine the details of a typical power installation of the sort just hinted at.

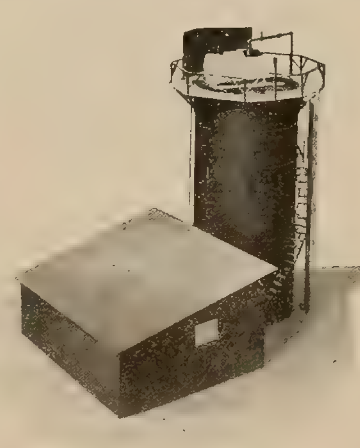
First, we shall describe the socalled steam cycle, or the journey of the steam-making water from the time it enters the steam boiler until it has passed through the turbine, or power unit, and returned again to the boiler; secondly, we shall consider the circulating water which is necessary in large quantities to convert the exhaust steam back again into water; and thirdly, we shall also touch briefly upon the journey of the oil from the time it leaves the cars at the sidetrack until it disappears from the chimney as a flue gas. We shall also touch briefly upon the general size and functions of apparatus employed to accomplish these results.

The Steam Cycle.

The Storage Tank. The supply of water for steaming purposes is usually brought to a make-up or storage tank from supply wells either on the immediate premises or nearby property. If these are not found, it is brought from rivers, lakes, or other bodies in the vicinity, or in many cases is purchased from some water company supplying the municipality. The storage tanks are varied in size, shape and capacity from a small tank, used as a receiver and hot-well, to a number of tanks, large and small, used for storage purpose only.

The use of storage tanks depends upon the source and quantity of water supplied and the load carried by the plant. Where there is a steady and positive source of supply, the tank may be of small capacity. In some cases where the supply is small and the storage at different periods is unfit for use, larger storage and settling tanks are required, and at times even filtration and cleaning tanks also are employed.

Pumps for Storage Supply. The tanks above alluded to are filled either by pumps, gravitation flow, syphons, or piping from a water company's main. There seems to be no standard type of pump. Both reciprocating and rotary appear in standard practice. On the other hand, many plants have wells and water is lifted by air pressure. This, on account of the total absence of working parts, is particularly useful, where there are a number of scattered wells, and, also, when it becomes necessary to handle dirty water, that is,



Measuring and Purifying Tank for Water Supply at Redondo Plant.

water containing sand, grit, and dirt in suspension. This air lift consists of a partially submerged water pipe and an air supply pipe. The casing of the well is driven below the lift pipe. The lift pipe is set in the well either with air surrounding it between the pipe and the casing or with a cap over the casing, making the space in the casing air-tight. In some instances the well casing is used directly as the lift pipe.

The Hot-Well. The water from the storage tanks is either pumped or is caused to flow by gravity to a socalled hot-well. The hot-well is a tank which stores the water before it passes to the feed-water heater. It receives water from the condenser and admits an additional supply from the storage tanks to meet the needs of steam generation.

Feed-Water Pumps. From the hot-well, water is taken through feed-water pumps into the feed-water heater. The function of a feed-water heater is to heat the entering water to a temperature approximating that of evaporating conditions in order to keep the boiler at as even a temperature as possible and at the same time to put the exhaust steam from the auxiliary apparatus to some useful purpose.

Feed - Water Heaters. These are divided into two general types: open and closed. In the open heater the steam comes in direct contact with the cooling water, and if there is a sufficient quantity of steam, it raises the water to 212 deg. F., the excess steam passing to the atmosphere. In a closed heater, on the other hand, the water is not exposed to the air and, if necessary, can be raised to boiler temperature. The water from a closed heater is as a rule much cleaner, since at high temperatures the deposits and minerals in solution are precipitated

The Redondo Power Plant of the Pacific Light & Power Corporation, With Oil Storage Tanks.

In steam plants where closed feed-water heaters are used, the boiler feed pumps are placed before the heater, thus pumping through the heater to the boiler. When open feed-water heaters are used, however, the boiler feed pumps are placed between the heater and the boiler.

Economizers. Economizers are sometimes installed in place of feed-water heaters. The economizer is a series of pipes through which the feed-water passes, placed in the path of escaping gases from the boiler furnace.

The Boiler. The boiler next receives the water from these heaters and converts it into steam at the desired pressure and temperature. The main types of boilers are water and fire tube. Modern practice indicates a decided preference for water tube boilers. A water tube boiler consists of steam and water drums placed on the top and a mud drum placed below, the two being connected by a series of tubes filled with water or steam. The fire is below these tubes, and the heat from the furnace is made to pass around them several times by means of headers or partitions, thus supplying heat for steam generation.

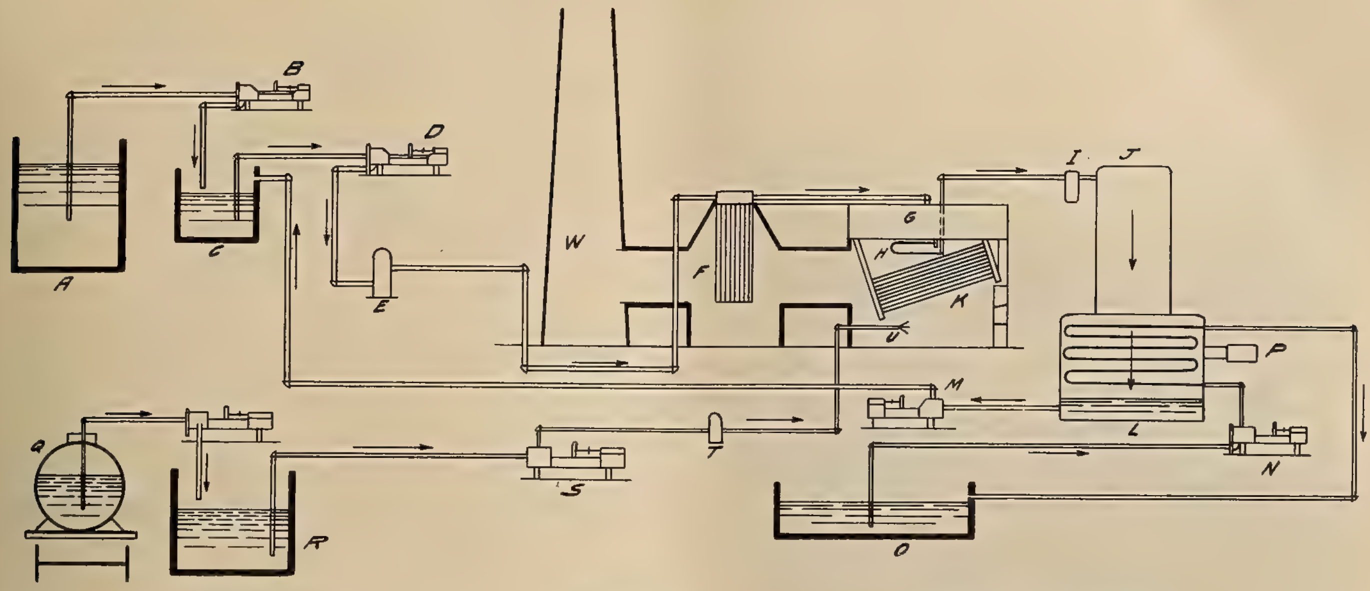
The Superheater. The water being thus converted into saturated steam by heat from the furnace of the boiler, is next passed through a series of tubes known as a superheater. These tubes are exposed in a heated portion of the furnace and thus the steam is raised to a point much higher than its saturated temperature.

The Separator. From the superheater the steam passes through suitable piping to a separator, placed between the boiler and the engine, or between the boiler and the turbine. This separator is placed as near the power unit as possible in order to remove all condensed steam that may be found in the pipes. One form of separator performs its function by quickly reversing the direction of the flow of steam, thus depositing the water into a drip which is drained off into the condenser. Another form gives a rotary motion to the entering steam thus hurling particles of water off by centrifugal force and collecting it in proper receptacles. Again, baffle plates are at times employed wherein the flow is interrupted by corrugated or fluted plates, and the particles of water adhering to these are then drained off.

Reciprocating Engine or Steam Turbines. The steam next goes from the separator to the main power generating units. The main units in earlier practice were reciprocating engines; in modern installations they are steam turbines.

Reciprocating engines may be divided into several classes, the details of which will not be outlined in this general discussion. Suffice it to say, however, that the main principle upon which reciprocating engines act is that steam enters a cylinder under pressure, thus forcing ahead a piston which is connected to a crank arm, thereby causing rotation and the consequent generation of power.

Steam turbines are divided into two general classes known as impulse turbines and pressure turbines. In the impulse turbine steam is allowed to expand in passing through a nozzle, thus causing the steam to travel at an enormous velocity. The steam, having acquired this velocity by impinging against movable blades, causes rotation and the consequent generation of power. In the pressure turbine, however, the steam is allowed to enter the buckets or rotating vanes at a comparatively low velocity. These vanes are so designed that the steam may expand in this movable portion and by means of its expanding



A = Supply water source.
B = Supply pump.
C = Hot well.
D = Feed-water pump.
E = Feed-water heater.
F = Economizer.
G = Boiler.
H = Superheater.
I = Separator.
J = Turbine.
L = Condenser.
M = Wet vacuum pump.
N = Circulating water pump.
O = Large water source
P = Dry vacuum pump.
Q = Railroad oil tank.
R = Storage tank.
S = Oil feed pump.
T = Oil heater.
U = Oil burner or atomizer.
K = Furnace.
W = Smoke-stack.

A Diagramatic Sketch showing the Steam, Circulating Water and Fuel Oil Cycles in the Modern Power Plant.

pressure cause rotation and hence the generation of power.

Turbines as a general rule have two other classifications, known as vertical and horizontal. The vertical turbine revolves upon a vertical shaft, which is supported at the bottom by a thin film of oil under the high pressure of about 900 to 1000 lb. per in. The horizontal turbine, however, as the name indicates, rotates on a horizontal axis, and is supported in the usual manner by means of suitable bearings.

Condenser. From the steam turbine, the steam, having expanded to its useful limit, is dropped into an incasement through which cool water is being passed. Upon coming in contact with this cooling device the steam is again converted into water. The apparatus performing this function is known as a condenser, there being two general classes: surface condensers and jet condensers.

In the surface condenser the steam from the turbine and the cooling water from a nearby source of supply do not come into direct contact, but the cooling water is passed through inclosed tubes around which the steam from the turbine or power unit is made to pass. This type of condenser is used where large quantities of water are available for cooling purposes but not for steaming purposes. Thus the use of salt water, the only abundant supply available for ocean-going steamships and large power plants situated near the ocean, makes a condenser of the surface type imperative for such installation.

In the jet condenser the supply of cooling water is allowed to mingle with the steam as it drops from the turbine or power unit and thus the steam is at once condensed into water. The water from the jet, being pure in supply, may be used in the hot-well for steam purposes.

Wet Vacuum Pumps. The condensed steam, now in the form of water, is pumped from the condenser back again into the hot-well by means of what is known as the wet vacuum pump. This pump may be either a reciprocating or rotary pump, but in general the rotary type seems to have the preference. Thus the entire cycle for the water is traced from the make-up tank or hot-well through the boiler and power unit, and back again to the hot-well.

Dry Vacuum Pumps. The condenser also has a dry vacuum pump in order to remove from the steam space within any air which may have been trapped from the steam generated in the boiler. This pump is nothing more nor less than an ordinary air compressor so designed that it will take air at a very low pressure and compress it up to atmospheric pressure, thus pumping, as it were, into the outer atmosphere such air as may have been entrapped in the condenser.

Circulating Water Cycle.

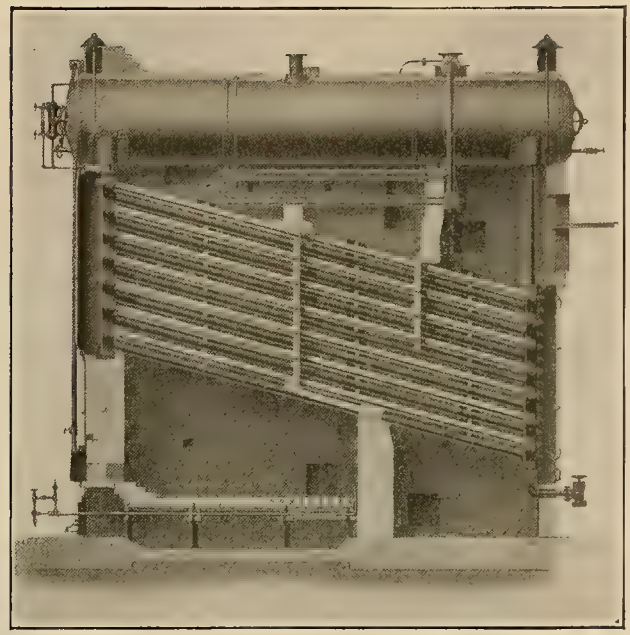
From the description of the working of the condenser it is seen that cooling water is necessary to convert the steam in the condenser back again into water. This cooling supply is known as circulating water, which is usually taken through pipes from some large natural lake or river or even the ocean and forced by means of reciprocating or rotary pumps through the condenser back again into the open. The water in its journey is raised in temperature in the surface condenser system from 25 to 30 deg. F. above its entering condition.

The Oil Cycle.

Of general interest to boiler testing and operation is the oil cycle employed in the utilization of crude petroleum as a fuel. Let us then briefly trace the journey the oil makes through the modern power plant.

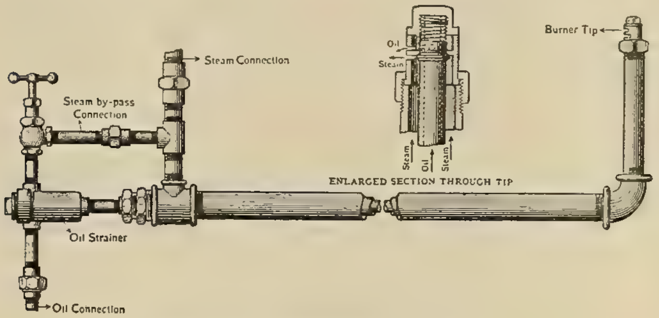
In the larger installations the oil is sidetracked from the main railway line in specially designed cars for its easy conveyance and handling. An oil heater,

consisting of a coil through which steam is passing, is lowered into the car in order to warm the oil as it is drawn, thus making its transfer considerably easier. By means of a pump this oil is then taken into a stor-



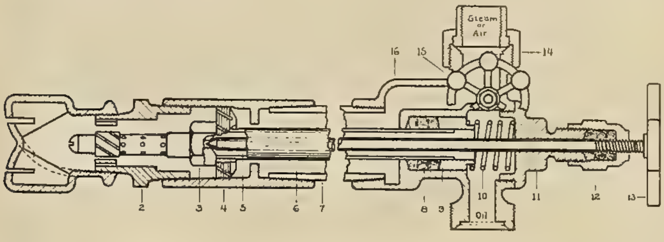
Cross-section of the Babcock & Wilcox Boiler—Oil-fired.

age tank which may be of wood, steel, or concrete, depending upon the permanence of design thought necessary. From this storage tank the oil is pumped through oil heaters, the exhaust from the pumps in many cases being utilized in still further heating the oil before it reaches the burner or atomizer.



The Peabody Fuel Oil Atomizer.

An atomizer is a device used to vaporize or spray the oil into the furnace in fine globules or particles. This is accomplished by means of steam, air, or some mechanical contrivance. Immediately upon its being



The Staples & Pfeifer Fuel Oil Atomizer.

sprayed into the furnace carefully designed air regulating devices admit sufficient air from below to cause perfect combustion. The heat thus liberated from the oil due to its burning with the oxygen is caused to flow in and around numerous tubes through which water is passing and thus this water is converted into steam. After passing these tubes the heated flue gases brought to life by the burning of the oil with the entering air are then conducted through the chimney out into the atmosphere.

As an instance of excellent design in fuel oil practice, let us briefly review the fuel oil equipment of the Redondo plant of the Pacific Light & Power Company.

The oil is pumped under pressures which vary from 10 to 50 lbs., depending on load conditions. There is a uniform oil pressure throughout all portions of the plant. All burners run wide open, or nearly so.

The amount of oil burned, with variations of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing or decreasing in all boilers simultaneously.

The oil pressure is automatically controlled by a steam pressure regulator. The variations in the oil pressure and the intensity of the fire are such as to maintain a uniform steam pressure on the plant.

The steam for atomizing purposes is supplied by a separate low pressure main. The pressure in this main is automatically controlled by the variation of the oil pressure in the oil main. A ratio regulator is used, automatic in its action, which maintains such a steam pressure in the low pressure main as is necessary to atomize the amount of oil burned. In this plant the proper amount of steam for atomization is furnished under a steam pressure equal to three times the oil pressure, plus 30. This relation, of course, varies and depends upon the burner used.

The air supply for combustion is controlled by a damper controller, automatic in its action, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is due to the oil pressure on a diaphram. This movement is opposed by a spring such that the amount of movement on the main lever is proportional to the oil pressure. Power for its operation is secured by means of a hydraulic cylinder which connects to a rock shaft and controls all the boilers from one panel. The connecting levers are set at such angularity as to give the proper air supply at various loads.

General Summary.

Thus it is seen in this brief description that by using crude oil as fuel three main cycles of operation are synchronously carried on in the modern power plant. Briefly summarizing, these are as follows:

Water is taken through the boiler, converted into steam and passed through a driving mechanism, after which the steam is reconverted into water and this water again passed through the boiler. Simultaneously with this action water is being pumped through the circulating system to bring about the conversion of the steam from the power unit into water. Again oil in a finely atomized or gaseous state is being fed through pipes into the furnace, where it immediately combines with the proper quantity of oxygen from the entering air, and thus sufficient heat is liberated from the oil to evaporate the water supply of the boiler into steam for power generation.

SPARKS—Current Facts, Figures and Fancy

More and more it is being established that the electric drive for battleships has undoubted superiorities over any other known method of propulsion.

* * *

Law and order have finally been restored in the Atlanta, Georgia, reign of terror over the street railway traffic situation in which thirty-one cars were dynamited.

* * *

Even the turtle is feeling the impetus due to growth in foreign activity of the United States. Costa Rico has granted a concession to certain American citizens for the fishing of huge three hundred pound turties along her beaches and waters for the next five years.

* * *

In Eastern states it is being urged to get more and more the full value of coal by recovering its useful by-products when combustion has taken place. The recovery of by-products from fuel oil consumption on the Pacific Coast might with much profit be investigated.

* * *

The Bureau of Standards at Washington is becoming more and more to be recognized as an institution that occupies toward manufacturing an indispensable relationship. The wide range of research activity undertaken is proving of immense value to industries the country over.

* * *

"The Christmas Electrical" was evident in all cities of the West. Especially was this true among the smaller communities such as Lodi, California, where the electrically illuminated Christmas tree erected in the public throughfare near the railroad depot, greeted the passenger traffic of an empire during Christmas week.

* * *

The new Rochester electric street cars which have been named the "Car Rider's Car," are said by the Electric Railway Journal to represent the last word for street car evolution in the matter of wide entrances, anti-flashing controllers, anti-friction bearings, liberal window area and conspicuous route signs with front and center exits for passengers.

* * *

The governmental railroad now being built in Alaska from Seward to Fairbanks will do more than any other single factor in unlocking the vast natural resources of this section of North America. The road is to be 466 miles in length, of which a distance of 136 miles has been built and is now in daily operation. The total cost is to be over twenty-five millions. Eleven millions of dollars have already been spent upon the work. Four thousand men are now employed.

* * *

Port Kembla, when it is finished, will be one of the finest harbors of New South Wales. The work of construction in connection with the breakwater and wharfage accommodations has been proceeding for fifteen years, but is now nearing completion. The port is situated fifty miles south of Sydney and is destined to be the shipping port for the bulk of the coal from the southern fields.

* * *

Foreign countries are showing deep-seated appreciation for their great captains of industry and engineering during the present international war. Sir Albert Stanley, the founder of the present excellent transportation system in London, has been appointed to the British Cabinet. In America, too, the public are more and more clamoring for the trained analytical mind of the engineer in the conduct of public affairs.

* * *

It is not stated in the reports that the electric lamp is the cause of the disappearance of the sperm whale from northern latitudes, yet who knows but what his jealous animal instinct has led him to frequent more and more the latitudes to the south. At any rate most of the whale fishing of Norway is now done in the Southern Hemisphere. The total catch last year yielded four hundred sixty-five thousand barrels of whale oil valued at about seven million dollars.

* * *

It is highly probable that rice production which has been found so profitable to the grower and to the hydroelectric power companies in California, will also extend to other countries to the south. In two coast departments of Peru the cultivation of rice claims the attention of the greater part of the inhabitants. The yield is about fifteen hundred pounds per acre. The total production last year amounted to forty thousand metric tons.

* * *

As in the economic development of the public utility, monopoly under public regulation proves to be the ideal method of evolution, so in the growth of western cities unified interest with neighborhood reservations is the trend of municipal growth. The new San Francisco, combined with Oakland, Berkeley, Alameda and other neighboring cities nearby setting forth nearly a million inhabitants is a proper goal for centralization of municipal effort in California.

* * *

With an advertisement headed "Joslin's the Daylight Store," this firm has made known to the Denver public that it is using this form of illumination. The body of the advertisement relates that the daylight lamps are being used throughout the store and in the show windows, further stating the advantages of this illumination in the matching of colors and discerning workmanship, etc. A description of the lamp follows —telling of the rays sent out, that they are blue instead of yellow, and that they imitate natural daylight as no other form of illumination can do.

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ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

THIRTY YEARS OF SERVICE.

With this issue of the Journal is inaugurated the thirtieth year of its eventful life. During this period it has been its privilege to chronicle and comment upon all the now famous engineering events that have made engineering activity in the West known the world over. Its editorial columns have been read and quoted in practically every country of the civilized world and its message of scientific and engineering discernment has been favorably received by a host of loyal friends wherever its pages have been read.

The new Journal—the Journal that now addresses as an audience the countries bordering the great Pacific—goes forth with the strength and courage acquired from years of careful training and nourishment to assist in building up the greatest commercial and engineering arena that has ever before been exploited in the history of human activity. The Journal greets the countries bordering the Pacific with its spice-laden islands, and offers to them its banner of thirty years' standing, "at your service."

A Journal founded upon broad principles of justice and education, like the state university, never dies. Hence, in the prime of its manhood, in full knowledge of its splendid achievements of the past, the Journal of Electricity pushes on, pausing for this moment only to note the passage of a friendly mile post—"Thirty years of Service."

Commercial and Engineering Interchange

A new era of commercial and engineering activity is being ushered in upon the Pacific area that in its incipiency must be launched upon the broadest principles possible to international interchange.

In the past many things have arisen sometimes with, but more often without foundation in fact, to mar friendly intercourse with certain of the countries bordering the Pacific.

It is now almost universally recognized that in order to attain the utmost in human interchange all parties to the issue must partake of the benefits to arise from a contract of interchange else sooner or later it will be found that the contract is in force by name only. Domination of interest—that interest which says, "I, the great I, am to be the favored one," has done more to create inharmony and disrupt nations than any other factor. For a forceful example of this witness the present international war in Europe.

In view of this fact it would seem an excellent and opportune time to lay broad lines of commercial and engineering regulation for the countries bordering the Pacific so that from the start evil practices that were possible in America before the advent of the modern regulating commissions may be avoided.

By so doing the strong bonds of community of interest among those countries as a unified whole, will be immeasurably strengthened and the ties of com-

munity of race and religion so flagrantly lacking be made to appear of little importance.

In a word what is needed is a body of highly representative engineers and business men called trom the individual countries bordering the Pacific, either legally designated or voluntarily called from the engineering and commercial organizations of the countries to properly pave the way for the international activities ahead.

These activities will not come suddenly. Their growth will be slow, but under careful nourishment they will be substantial in nature. A basis of common understanding is the first necessity. This common understanding may be easily established in this day of first things in the great Pacific arena of commercial and engineering activity and in this day of first things the engineer should play the leading role.

The Growing Importance of Fuel Oil

The recent "scarcity of oil scare" has arisen not so much from any anticipation of shortage in oil production as from its now universally recognized advantages in the generation of power. This is especially seen in the trend of marine design. The enormous increase in shipbuilding on the Pacific Coast has served vastly to strengthen this utilization of fuel oil operation.

But the factor that is contributing more than any other to creating the scare of fuel oil diminution is the extreme importance of fuel oil operation in the propulsion characteristics of the modern navy. The cleanliness of supply, the ease of manipulation, the reduction of storage space, and the increased efficiency under fuel oil operation are factors that lead naval experts to place fuel oil so far above other means of power generation as to make other methods of power generation appear insignificant in comparison.

This growing importance of fuel oil applications in the generation of steam has brought about a renewed interest among engineers and operators in the study of fuel oil and steam engineering.

To meet this pressing demand for first hand educational knowledge along these lines there is inaugurated with this issue a series of articles on "Fuel Oil and Steam Engineering" which will deal with practically every phase of the subject matter suggested in the title. The articles will each be independent of the other as they appear from time to time, yet taken as a whole they will constitute a valued contribution to this important phase of modern generation of power.

Central Station Merchandising

One of the livest questions before the electrical men of the West today is the tendency of central stations to sell electrical appliances in general and ranges in particular. It is much like the old question of selling lamps, but is minus the argument that this is a necessary part of the power company's service to the consumer. Good reasons for and against the practice are presented by both sides.

The central stations have found that the expenses of a range selling campaign have been too great for the average electrical dealer to undertake. Where this class of business is left to the dealers' initiative the sales lag. Consequently the central station is deprived of this desirable load.

Consequently, many power companies have taken the matter in their own hands and are successfully conducting electric range campaigns. They carry on extensive advertising and demonstrations, they employ expert salesmen and they personally see that all ranges are giving satisfaction after being put into service. As far as the receipts from the sales are concerned, this business is conducted at a loss of about $25 for each range installed at the list price. This deficit is made up later by the sale of current.

The central stations argue rightly that no dealer can afford to assume the burden of this promotion work. The electric range is still in the exploitation stage. The public has to be educated regarding the advantages of electric cooking. And so in order to quickly get the off-peak cooking load the power company is compelled to carry on this creative sales work. Furthermore they feel that as they are bearing the cost of the work ordinarily done by both the jobber and the retailer they are entitled to at least as low a price as is given the jobber.

The jobber and dealer, on the contrary argue that the central station is disorganizing the entire electrical industry by selling appliances, especially when they cut below established prices. Their creed recognizes four well established branches in electrical trade—the manufacturer, who furnishes the material, the jobber who stocks and distributes it, the retailer who sells it, and the central station who furnishes the current which operates it. They believe in the policy of live and let live, that each branch should confine itself strictly to its legitimate functions, and that any encroachment upon the prerogative of the other should be inhibited. They contend that the central station has no more right to sell appliances than has the dealer or jobber to sell current.

A logical way out of this conflict of ideas would seem to be for the central stations to devote the time and money they are now expending to educate the public to the education of the dealer. Instead of working against the dealer it is suggested that they work through them, even to the extent of losing their salesmen to the dealer. In this way they could get an even greater volume of business and incidentally win the good-will of the jobber and dealer.

Of far greater inportance to the central station that any immediate expedient in load-building is the necessity for developing friendly relations with the public. Each salesman of each jobber and each dealer is in the public mind a representative of the electrical industry. In the aggregate they form a great army capable of making or marring a favorable public sentiment toward the central station. By upholding the hands of the dealer the central station is thereby strengthening its own position with the public. It would therefore seem that any temporary advantage in accelerating the growth of off-peak business should not counterbalance the broader benefits to be derived from a harmonious electrical industry—"each for all and all for each."

PERSONALS

A. R. Parsons, of the A. R. Parsons Electric Company of Porterville, California, was a recent business visitor at San Francisco.

Charles E. Eyman, of the Standard Electric Company of Visalia, Cal., spent a few days in the latter part of the week at San Francisco.

T. E. Bibbins, president of the Pacific States Electric Company, has returned from an extended business trip throughout the East.

Martin Behrendsen, purchasing agent for the Valley Electric Supply Company, of Fresno, was a recent business visitor at San Francisco.

W. C. Johnson, representative of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from a vacation at Red Bluff, California.

R. L. Taylor, electrical contractor in Seattle, Wash., is a recent arrival at Los Angeles and expects to spend a few days in San Francisco on his return to Seattle.

J. P. Bell, Pacific Coast manager of the Standard Underground Cable Company, recently returned to San Francisco from an extended business trip throughout the East.

F. D. Fagan, manager of the Edison Lamp Division of the General Electric Company on the Pacific Coast, has returned to San Francisco from a ten days' trip to Los Angeles.

H. W. Doubrava, for many years with the New York office of the Wagner Electric & Manufacturing Company, is now connected with the Los Angeles office of the company in the sales department.

F. H. Leggett, formerly Pacific Coast manager of the Western Electric Company at San Francisco, expects to leave for the East by January 5th, where he will resume his duties with that company in New York.

E. C. Bennett, Mercury of the Jovian Order, has been added to the board of directors of the Society for Electrical Development as the Jovian representative, **Henry L. Doherty,** Jupiter, already being president of the Society for Electrical Development.

Max Loewenthal, lately with the Dohrmann Commercial Company, has returned to San Francisco from an extended trip throughout the East, and has opened offices for the United Trading Company, handling a number of electrical sales agencies.

Oscar C. Roos, radio engineer, is at San Francisco from the Philippines, where he has had charge of the wireless station for a number of years. Mr. Roos is a pioneer in the wireless work, having been connected with the Schumaker & De Forrest Company in 1903, and for years was chief engineer for the Radio Telegraph & Telephone Company on the Great Lakes. He was the inventor of the first commercial arc while connected with the National Electric Signaling Company as research engineer.

Winfred B. Holton, Jr., formerly assistant director in supervision of New York State Work, has been appointed director of the San Francisco Bureau of Municipal Research from January 1, 1917, and will shortly assume his new duties in San Francisco. Mr. Holton is a graduate of Wesleyan University, has made intensive studies of public works administration in Philadelphia and in the Borough of Manhattan, New York City, and subsequently he continued public works specialization and made surveys in Springfield, Mass.; Waterbury, Conn.; Toronto, Canada; Portland, Ore.; Denver, Colo.; Milwaukee, Wis.; Rochester, N. Y.; Buffalo, N. Y.; Alleghany County, Pa.; Monroe County, N. Y., and Brandon, Canada.

MEETING NOTICES.

Los Angeles Jovian League.

With Jacob H. Leeds of the General Electric Company as chairman of the day on December 20th a large crowd gathered to personally extend the compliments of the season and enjoy the double-header bill. Harry C. Carr, assistant managing editor of the Los Angeles "Times," gave an interesting address on "America's Position Commercially at the Termination of the War." H. H. Cudmore, director of the Mazda Bureau of the General Electric Cimpany, in characteristically happy style took a "Ramble at Random." The entertainment feature was well cared for by Miss Mercedes Crecelska, a young Polish artist with an unusual voice who sang some favorite selections in costume.

San Francisco Electrical Development and Jovian League.

The Christmas spirit pervaded the December 20th lunch. R. F. Behan, as Santa Claus, presented every one of the 80 members present with a gift from the electrically lighted tree. Past President Cutting was presented with a handsome piece of pottery as a loving cup. After the distribution of gifts President L. H. Newbert introduced T. E. Collins as chairman of the day, who in turn introduced Miss Bessie Beatty of the San Francisco Bulletin. Miss Beatty explained her work in providing Christmas stockings for 2500 poor children at Christmas time and also in maintaining a summer vacation camp. She was given a rising vote of thanks and also carried away a stocking well filled with coin to aid the good cause.

Joint Meeting of Portland Sections N. E. L. A. and A. I. E. E. With the Oregon Society of Engineers.

The bi-weekly luncheon of the Joint sections of the N. E. L. A., A. I. E. E. and the Oregon Society of Engineers was held at noon December 20th, in the orange room of the Oregon Hotel, Portland, Oregon. E. G. Hopson, consulting engineer and vice-president of the Oregon Society of Engineers, was chairman of the day. Fifty were in attendance. Judge C. U. Gantenbein gave a short talk on "The New National Defense Act," with special reference to the Engineers' Reserve Corps. There will not be another meeting of the luncheon club until January 17th, at which time the General Electric Company will have charge of the meeting with E. F. Whitney, chairman.

Oregon Society of Engineers.

The regular monthly meeting of the Oregon Society of Engineers was held in the ladies' dining room of the Oregon building, December 22d.

W. S. Turner, president of the Oregon Society of Engineers, presided as chairman, and the whole evening was devoted to talks on electricity. O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, spoke of "Recent Achievements in the Electrical Field." R. R. Robley, operating engineer for the Portland Railway, Light & Power Company, discussed "Historical Phases of Electricity," with special reference to local conditions. W. H. Lines, commercial engineer for the Portland Railway, Light & Power Company, told of the "Commercial Application of Electricity."

An amendment to the constitution was proposed and will be voted upon later. The vote will be upon the proposed change of the president's term of office to one year instead of two years, and the vice-president's term of office to one year instead of two years, and make them not eligible for re-election for two successive years.

The architects of Oregon will have an architects' license law introduced before the Oregon legislature this year, and they asked the Oregon Society of Engineers for their support. It was referred to the legislative committee. This bill provides for an examining board of five members, and

requires all architects to register and be passed upon by the board. Those eligible must have engaged in business a specified period of time or worked for another concern which has been in the business. The law is modeled after the New York law.

The Oregon Society of Engineers has appointed a delegate to represent them in the Oregon Good Roads Conference, which is considering Good Roads Legislation. The society will also be represented at the Irrigation Congress, which meets in Portland the first of January, 1917. The attendance was twenty-seven.

THE OREGON IRRIGATION CONGRESS.

The Oregon Irrigation Congress will convene at the Imperial Hotel in Portland, January 4, 5 and 6, 1917. The main subjects to be discussed will be irrigation practice, federal aid, state legislation for irrigation districts, needs of Oregon irrigation projects, financing of irrigation projects, cooperation with federal departments to assist Oregon irrigation development and the use and misuse of water.

NOTES OF THE PUBLIC UTILITIES COMMISSION OF IDAHO.

In reference to the application of J. E. Marsh and H. B. Logan, a co-partnership, doing business under the firm name and style of Marsh & Logan, for certificate that present and future public convenience and necessity require the construction of an electric power plant to supply the village of Rockland and four surrounding townships, all in Power County, Idaho, with electricity, the commission granted the request.

In the matter of the application of the Idaho Power Company for a certificate of convenience and necessity for an extension to and within the village of Eden, Minidoka county, Idaho, the application was granted.

Village of Roberts, Complainant, vs. Ashton and St. Anthony Power Company, Limited, defendant. Utah Power & Light Company, Owsley-Carey Land & Irrigation Company, Mud Lake Canal Company, North Lake Canal Company, Crystal Lake Irrigated Lands Company and various farmers owning lands under the Butte and Market Lake Canal, Intervenors. The commission ordered the case dismissed.

SEATTLE'S PARTICIPATION IN AMERICA'S ELECTRICAL WEEK.

BY R. W. CLARK.

Seattle participated in America's Electrical Week by organizing an Electrical Show which was open afternoons and evenings December 4 to 9 inclusive. The entire second floor of the O'Shea Building at Fifth avenue and Pine street, with an area of about 9000 square feet was secured for the purpose. A large number of 1000 watt units, colored festoons and an electric sign made the outside of the building the brightest spot in the city.

Publicity material furnished by the Society for Electrical Development was used on billboards, in street cars, through the mails and through local electrical houses. This week and the success of the show held last year secured an attendance that was all that could be desired.

A large majority of Seattle's electrical interests took space, installed good exhibits, and conducted continuous demonstrations, so that there were no "dead spots" among the displays. All the energies of the show committees were devoted to making the event mainly an electrical educator for the public, and no entertainment features, except good music, were furnished. It is the belief of all concerned that the public took the show in the spirit in which it was offered, and it was noted by all exhibitors that the questions asked by the public were not prompted by curiosity but by a real desire to know about the latest developments in electrical appliances. As was the case last year, electric ranges and other cooking appliances held first place in public interest.

The direct results of such an exhibition are always hard to determine, but we note that our appliance sales during the week were just double those of the previous week, and we are working on prospects which should result in the sale of a large number of electric ranges and many small appliances within a short time. The other exhibitors report similar results, and are apparently well satisfied with their participation in the show. Furthermore, the spirit of co-operation shown by competing jobbers, dealers and contractors is very gratifying.

We think that such an electrical show, with free admission is the best method of reaching the public in America's Electrical Week, and expect that it will be made an annual event here.

The following list gives the names of the exhibitors, and the nature of their display:

The Perfectalite Co., lighting fixtures.
Electric Sales Corporation, water heaters and bakery ovens.
Automatic Controller Co., electrical heat controllers.
Puget Sound Traction, Light & Power Co., ranges, appliances, water heaters.
Instantaneous Alarm Co., public and private alarm systems.
Coin Machine Mfg. Co., induction water heaters.
Globe Electric Co., ranges and appliances.
Northwestern Supply Co., ranges, appliances, lamps, batteries.
Metropolitan Electric Co., switchboards and cabinets.
North Coast Electric Co., ranges, appliances, lamps, compressors.
Fobes Supply Co., ranges, appliances.
DeLay Sales Co., vacuum cleaners and washing machines.
Electrical Contractors' Association.
Pacific States Electric Co., appliances, charging sets, lamps, laundry machinery.
Lushington Electric Co., lighting fixtures and appliances.
A. H. Cox Co., small motors, repairing and electrically operated tools.
Delco-Light, lighting systems.
A. G. Behreman, Inc., lighting fixtures.
Kilbourne & Clark, radio systems.
Sunset Electric Co., electrical appliances for automobiles.
Western Electric Co., ranges, appliances, lamps, telephone sets.

TRADE NOTES.

The Holabird-Reynolds Electric Company, announces a change of name to the Graham-Reynolds Electric Company, jobbers of electrical supplies, 300-302 East Third street, Los Angeles. Broadway 200, Home 10555.

The Wagner Electric & Manufacturing Company of St. Louis announces that its San Francisco office will remove to 159 New Montgomery street to combine with the service station of the company.

UNITED STATES CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an open competitive examination for assistant examiner in the Patent Office, for both men and women, on January 17, 18 and 19, 1917. From the register of eligibles resulting from this examination certification will be made to fill vacancies as they occur in this position at the entrance salary of $1500 a year, in the United States Patent Office, Washington, D. C., unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

NEW BULLETINS.

The General Electric Company has just issued bulletin No. 44417 on The G.E-258 Ventilated Commutating Pole Railway Motor.

The Chicago Pneumatic Tool Company has just issued Bulletin 34-W on "Giant Fuel Oil Engines," and Bulletin No. 263 on Boyer Railway Speed Recorder.

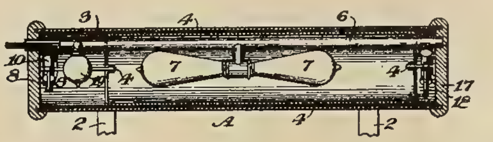
The Underwriters' Laboratories has recently issued a booklet of twenty-four pages on Electrical Data. This booklet contains valuable research information relative to methods of fire prevention from electrical sources together with a discussion of causes that have produced fires in the past from electrical defects in the wiring installation.

WHAT WESTERN INVENTORS ARE DOING

(On this page may be found a brief description of typical patents just issued to inventors in the West.—The Editor.)

1,208,302. **Vehicle Signaling Device.** Robert F. Duryea, San Francisco, Cal.

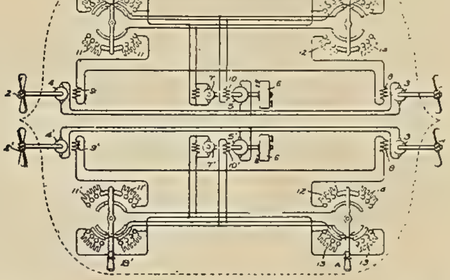
A vehicle signaling device, a cylindrical casing having closed ends and sight openings in its periphery, an inner cylinder having its ends closed and spaced from the ends of the casing to form end compartments, longitudinally arranged shafts fixed to the casing ends and rotatably supporting the inner cylinder, cylinder-rotating means arranged in one end compartment, between one end of the casing and the



adjacent end of the cylinder, the ends of the cylinder being formed with arcuate slots arranged in proximity to the periphery of the cylinder, a source of light arranged in the other end compartment between the opposite ends of the casing and cylinder and visible through one of the sight openings, the adjacent closed end of the cylinder preventing the passage of light rays from said source of light into said cylinder, a source of light disposed in the cylinder and visible through another sight opening, and a tubular member fixed to each of the ends of the casing and passing through the arcuate slots of the ends of the inner cylinder to serve as a steadying means for the latter, said tubular member also having both sources of light connected thereto and constituting the sole support for the sources of light aforesaid.

1,208,429. **System of Electric Propulsion.** Merle J. Wightman, Seattle, Wash., assignor to General Electric Company, a Corporation of New York.

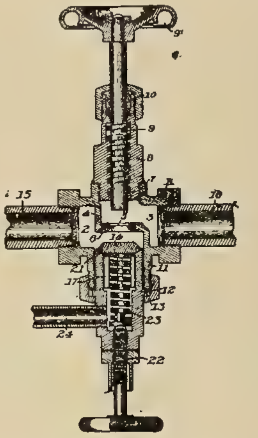
A system of electric propulsion of a vessel, propellers for said vessel located at the opposite ends thereof, an inde-



pendent motor for driving each propeller, and a controlling device near each end of the vessel for simultaneously controlling the motors at both ends and for maintaining a lower speed of the motor driving the propeller at one end of said boat than that of the motor driving the propeller at the other end.

1,208,292. **Valve.** Garnet W. Coen, San Francisco, Cal.

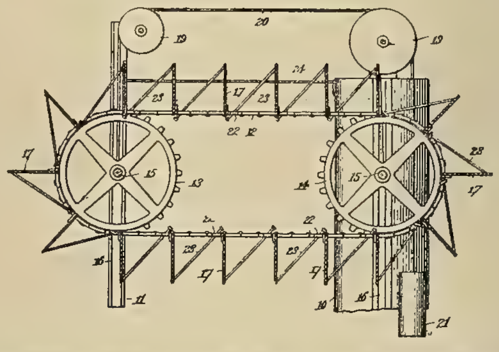
The valve casing having an inlet opening connected with a source of fluid supply under pressure and an outlet opening connected with a service line, of a pair of passages in the valve casing having valve seats formed therein, one of said passages forming communication between the source of supply and the service line, and the other passage forming communication between the source of supply and a return, a valve interposed between the valve seats adapted to be normally actuated by the fluid under pressure to close the passage between the source of supply and the return, mechanical means within the casing for automatically projecting the



valve against the opposite seat to shut off the flow of liquid through the service line the moment the fluid pressure drops below a predetermined pressure, and means for positively retaining the valve on its seat to prevent the automatic operation described.

1,208,611. **Water-Current Motor.** Warren C. Miller, Medford, Oregon.

A fluid current motor comprising a pair of hollow caissons arranged in parallel spaced relation and having the confronting faces thereof provided with vertically extending guideways, a pair of vertical beams arranged in spaced relation to the caissons and in alinement with the guideways, said beams being spaced from each other and having the con-



fronting faces thereof formed with vertically extending channels, shafts slidably mounted in the guideways and in the channels, sprocket wheels keyed to each of the shafts, said sprocket chains trained over the sprocket wheels, blades mounted on the chains, pulleys journaled at the upper ends of the beams and caissons, and weighted cables connected to the shafts and trained over the pulleys, said cables being secured to the opposite extremities of the shafts and lying in said channels and guideways.

LATEST IN EVERYTHING ELECTRICAL

(It is the purpose of this department to chronicle the very latest advance in industrial activity of interest to engineers. In this issue recent advances in office space design, electric railway signals, and ice making by electrical means are considered.—The Editor.)

RECENT ADVANCES IN ARRANGEMENT OF OFFICE SPACE.

BY WALDO C. COLE.

Office of the Manager.

THE definite disposition of each detail so that there is no necessity to give it further thought, saves time and permits those who find greater demands made upon them from day to day to easily assume responsibility without becoming overburdened.

In planning the new quarters of the Westinghouse Electric & Manufacturing Company, on the seventh floor of the First National Bank Building, San Francisco, it was recognized that a modern office would have to meet the conditions outlined above, besides adapting itself to those principles which have been recognized for a considerable period of time as standards.

In order that the clients of the Westinghouse Electric & Manufacturing Company calling at the office might be provided with equipment where they can give close attention to the problem under consideration, and not be confused with details of other work handled by the other salesmen, two conference rooms, one on each side of the district manager's office, opening into the reception room, are provided. As soon as the operator in charge of the information desk learns the desire of the caller, the interested representative is notified, who collects all the necessary papers and data that will be of interest to and required by the caller, then proceeds to the reception room and shows the caller into one of the conference rooms, where a telephone and large table and chairs sufficient to seat all interested are provided.

The sales force has been organized so that even if the man handling the caller's business is away from the office, a member of the office sales division can give his immediate requirements attention and transmit all of the necessary information to the salesman interested, who can later give further and more detailed study to the proposition.

The office sales division has quarters just off the reception room, where the necessary privacy is assured to those wishing to talk upon any details with the men of this division.

At one end of the large room, serving as the office of the salesmen, are two small offices; at the other end there is only one office. These small offices are used by the respective division managers. The men of each division are grouped adjacent to the office of their manager. This arrangement lends itself to the quick dispatch of essentials that must come to the attention of one of the division heads for advice or suggestion.

The offices of the treasury department are so situated that they can be easily reached by the members of the sales department and clerical division in order that the vital questions pertaining to this department can be quickly considered and disposed of; at the same time the arrangement assures the customer, who finds it necessary to discuss financial matters, the desired privacy and freedom from interruption, which is necessary for satisfactory consideration of questions of this kind.

The clerical department is housed in one large room, where each of the clerks can easily come in personal contact with any of the others if he should find it necessary to have additional information relative to the particular matter receiving his attention. This arrangement discourages a practice that naturally grows up where a clerical department is housed in more than one room, of saving up a number of documents to be discussed whenever it is found convenient to make a trip from one room to another; but rather encourages the quick, accurate and ready dispatch of the particular business at hand.

The promotion division has a room separate from the rest of the office, where provision has been made for the storage of publications and data, so that it is convenient for immediate access for mailing to customers who are interested in any particular development of the electrical art related to the Westinghouse Electric & Manufacturing Company.

An Interior Office View.

Although the products of the Westinghouse Lamp Company are not as diversified as the Westinghouse Electric & Manufacturing Company, and their local organization not at complex as that of the latter company, a close study was given to make their offices as efficient for handling their business as that of the former. Due to the smaller organization, it was found that the conference room plan could be dispensed with, and that the private offices of the manager and salesmen of the lamp company would insure their customers the privacy which is so essential in giving close consideration to the commercial details of an illuminating problem. There are two private offices provided, one for the manager and one for the salesmen.

The offices of both of these companies are laid out with an idea of giving their customers the best service that could possibly be obtained.

RECENT DEVELOPMENT IN RAILWAY SIGNALING.

Railway signaling has developed into an important branch of electrical industrial work. Automatic block signals, based on track circuit, are now standardized to a great extent and used by main steam and electric trunk lines. In subways and terminal yards, where traffic is heavy, block signals are essential to the safe and effective movement of trains, and the signal art has been developed to keep pace with modern high pressure conditions.

Special consideration is given the Simmen System in this article. The Simmen System is based on cab signals, as against fixed signals placed along the right-of-way. Cab signals not only have many legitimate reasons for their use, but in addition to effectiveness, they cheapen the first cost of installation and reduce maintenance costs.

Assuming that in the United States there is approximately four miles of track to every motive power unit, we have one signal equipment on one motive power unit to

Angle Iron Ramp Rails and Car Contact for Railway Signal Installation.

balance up against all the fixed signals that would be placed on four miles of track. Two fixed signals per mile is a fair average, which makes eight to one in favor of cab signals.

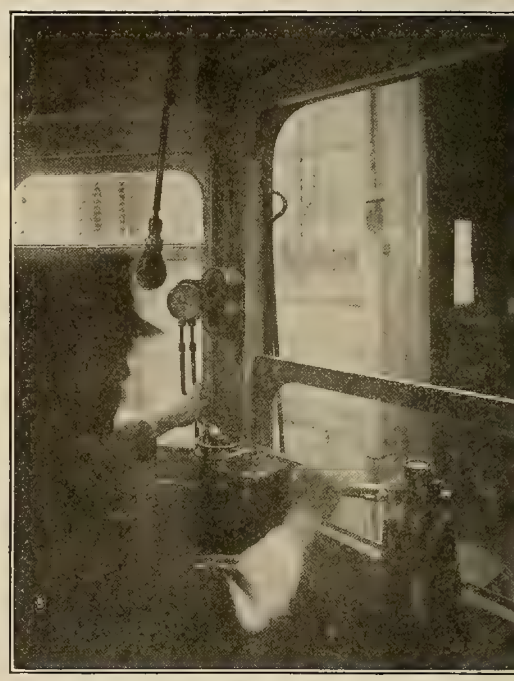
A charge against the cab signals, however, must be made in the cost of ramp rails, which are located at every signal point. Ramp rails are not an expensive consideration, since they consist of an angle iron mounted on insulated brackets, as shown in the illustration. The electrical contact to the car is made by means of a contact shoe mounted on the car truck, as shown. The signal indication is given by means of red and green lights in a signal box located in front of the engineer, as shown in the second illustration. The car apparatus consists of a battery for operating the cab signals, a polarized relay, a directional switch, the lamp box and the contact shoe above mentioned. The track apparatus is, of course, similar to that used in standard track circuit practice, except that ramp rails are installed at signal points.

The operation of the signal system may be expressed by a train movement as follows:

When the locomotive goes into service the directional switch is thrown in the direction in which the train is to move. In any case this will mean a red light in the cab. On leaving the terminal, if the block is clear, the locomotive will pick up a green light on the first energized ramp rail that it passes over. This green light replaces the red and will be carried through to destination if the line is clear. The green light is picked up by outside current flowing through the car relay when the shoe is in contact with the ramp rail. This outside current lifts the armature of the relay and makes it possible for the car battery current to flow through the green light circuit. On leaving the ramp rail the armature is sustained in its top position by means of the same current that lights the green lamp.

Any failure of the current on the car or any injury to the contact shoe will break the holding current and the armature will drop by gravity into a position which shunts the car circuit through the red light. If the car circuit has failed, and there is no red light, there exists a similar condition to "lights out" with fixed signals, which is always assumed to be equivalent to danger.

The practical application of ramp rails involves what is known as a "distant" rail and a "home" rail. However, strictly speaking, these two rails are simply one long, continuous rail, extending for the full train braking distance at maximum speed. In view of the fact that this distance may be 2500 ft. or more, the center section of the rail is removed so that there simply remains the far end for about 40 ft. and the near end, say 70 ft., connected together by a wire. This saves expensive rail location and serves the same purpose



Electric Railway Signals Produced in Cab of Locomotive.

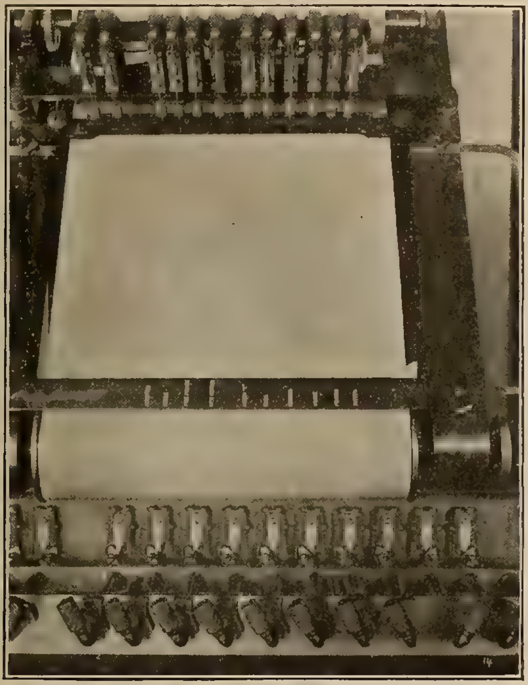
that a continuous rail would accomplish. The effect of a danger signal would be the same in either case.

The locomotive approaching the ramp rail that had been deenergized by means of a danger block condition (or defect of signal equipment) would have the green light changed to red as the contact shoe passed up on the ramp rail. Since the speed of the train may be very high at this point, the train would travel on to the far end of the rail (or what is known as the "home" rail) and come to a stop at that point. Stopping over the home rail is equivalent to stopping behind a red board, as with fixed roadway signals. The length of the home rail is made to accommodate the service on the road. An engineer running over a home rail would simply back up into position just as though he had run by a red the speed of the train may be very high at this point, the ing come to a stop, would then wait until the presence of energy in the ramp rail, picked up the car relay and restored the green light.

The principle of giving the first danger indication at an absolute predetermined point in advance of the signal location is quite different from fixed signal practice where the red board may be observed at varying distances, depending upon light and weather conditions; also background conditions and many other influences.

In the Simmen System the point where the engineer is first informed is always a fixed certainty.

A second important step made by the Simmen System is the method of enforcing obedience to signals, which is now crudely attempted by means of automatic stops of various types. In view of the fact that a circuit for signals has been once established on the locomotive, and that the signal indication changes at a fixed point in advance of the stop point, it is possible to introduce a speed control device that will operate on the air brake mechanism, if the speed of the train is not retarded as it should be. In other words, at any point between the "distant" and the "home" rails where the actual speed exceeds the speed as it should be retarded to insure a stop at the danger point, the speed control will reduce the speed automatically, and then restore the control of the train to the engineer until necessary to reduce it



Movement of Trains Recorded in the Dispatcher's Office.

again. An absolute violation on the part of the engineer would result in a series of applications of the air just about as he should do to bring the train to a stop, except that they will be somewhat later and more severe than usual service applications.

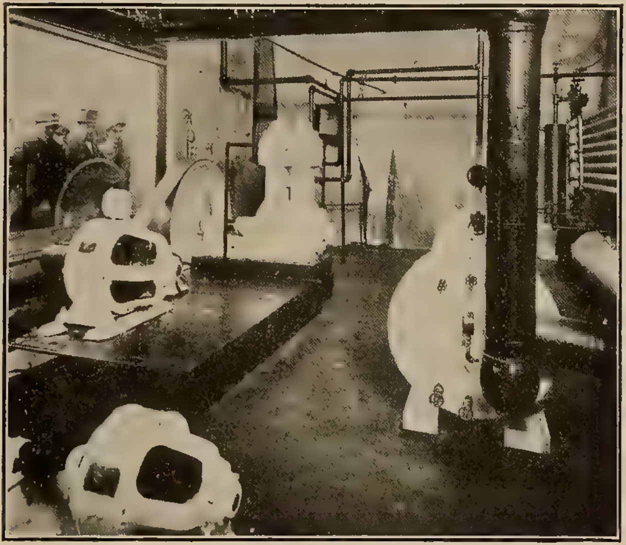
This particular solution of the problem of enforcing obedience to signals is modern and consistent with best practice in other departments of railroad operation..

With the restoring of the signal to clear the speed control device is cut out automatically, and, in fact, its presence is never apparent if the engineer does his simple duty.

A third development of the Simmen System is indicated by the third illustration, which shows the Simmen train record sheet, whereby the movement of trains is recorded automatically in the dispatcher's office. In connection with the record sheet there is provided a signal control lever for certain groups of signal ramp rails (usually all the rails located at one passing point) by means of which the dispatcher can at will deenergize the rails and give a danger indication to a train. These groups of signal rails are tied in to one wire, which extends direct to the dispatcher's office and to the lever controlling that point. This lever is connected to the positive side of a station battery when inclined to the right and to the negative side of a station battery when inclined to the left. In the vertical position there is no connection and the line is dead.

MOVABLE ICE PLANT FOR ROAD SHOW.

It is one thing to stage an ice ballet in the New York Hippodrome, where the show runs for an entire season, and quite another thing to transport a skating rink around the country with only a short run in each place. When it was decided to send the Hippodrome Company on the road, keeping intact the entire spectacles of "Around the World," including "Flirting at St. Moritz," the most brilliant ice ballet ever staged, the one serious drawback was the problem of furnishing a suitable ice pond. The adoption of the ice plant shown by the illustration proved to be the solution. The various units of this plant are transportable, each being mounted on a skid or stand, so that when the show closes it is only necessary to take down the piping, haul the different pieces of apparatus on a truck, pack them into a car and ship to the next showing place. To prevent the loss



Ice Plant in Operation.

of time required to erect the plant and freeze the water, which takes 24 hours, duplicate outfits are used. While one is working in one city the other is being set up at the next point, so that everything is in readiness when the company arrives. The first plant then goes to the succeeding point.

Each plant consists of a 10-ton York compressor, with two cylinders each 6½x6½ in., driven by a 20 h.p. direct current Westinghouse motor, and a 60 kw. Westinghouse motor generator set. Where direct current is available, the motors are operated from the power circuit, but as usually only one alternating current is to be had, the motor generator set is used to transform the alternating current into direct current for the operation of the motors.

The brine tank has a capacity of 1900 gallons. The ice pond formed on the stage is 45 ft. long, 20 ft. wide, and 4 in. deep. While being frozen, the water is held in place on the stage by a canvas tub.

These battery connections are identified with the direccurrent for the direction in which the locomotive is moving, when a signal rail is energized with the proper polarity of tional movement of trains for signal track operation, so that the engineer will get a green signal through the polarized relay on the locomotive. No current or current of the opposite polarity will cause the red light to burn. At the same time that the locomotive shoe makes the contact with the signal rail, the circuit through the dispatcher's office is completed to ground, and the record of the train at that point is punched on the dispatcher's sheet. This sheet moves at the rate of six inches an hour downwards.

The recent impetous of ice-skating on the Pacific Coast should make this new movable ice plant operation of unusual interest to electrical engineers.

NEW ELECTRICAL DEVELOPMENTS

(The constant stream of electrical development throughout the West is the very artery by means of which electrical activity is energized. Herein will be found the latest news in electrical development of this section.—The Editor.)

FINANCIAL.

LOS ANGELES, CAL.—In order that the city may be in a position to buy the distributing system of the Los Angeles Gas & Electric Corporation as well as the Southern California Edison and Pacific Light & Power Corporation systems, the People's Power bond committee of 100 have recommended to the Council that the bond issue be for $15,000,000. President Betkouski said that he would oppose a larger bond issue than the $12,000,000 proposed by the city power committee.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has transferred its utility properties to the Washington-Idaho Water, Light & Power Company, by deeds recorded at Lewiston, Asotin and Colfax, for a consideration of $1,000,000. The Washington-Idaho Light & Power Company was recently organized by Liggett, Hychborn & Company of New York and Boston, which firm authorized an issuance of $5,000,000 in bonds to cover the sale just completed and future developments and subsequently acquired property.

INCORPORATIONS.

SEATTLE, WASH.—The Valley Gas Company has been incorporated by C. W. Clark and F. T. Ellis, with a capital stock of $25,000.

BOISE, IDAHO.—The Canyon Light & Power Company of Wallace with a capital stock of $100,000 has filed articles of incorporation.

SEATTLE, WASH.—The Mason Electric Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are S. W. Mason and R. G. Kendrick.

RIVERSIDE, CAL.—Articles of incorporation have been filed by the Rialto Light & Power Company and also certificates of proceedings for changing the principal place of business from Rialto to Riverside.

ILLUMINATION.

IMPERIAL, CAL.—A contract has been signed with the Holten Power Company for lights for the streets here.

HANFORD, CAL.—The new owner of the Lacey electric plant proposes to install a new street lighting system.

CHICO, CAL.—The residents of Chico Vecino have petitioned the supervisors to call an election for the formation of a lighting district.

SEATTLE, WASH.—The validity of $3,000,000 bond issue authorized by the council for extending the light plant will be tested in the court.

BREMERTON, WASH.—A franchise for the installation of a gas plant has been granted by the city of Bremerton to E. L. Blaine of Seattle.

VISALIA, CAL.—South Bridge street property owners are considering plans for lighting their street by means of a system similar to that on West Main street.

KLAMATH FALLS, ORE.—An up-to-date street lighting system is shortly to be installed here by the California-Oregon Power Company at a cost of over $10,000.

WHITE SULPHUR SPRINGS, MONT.—P. J. Twohy completed a deal becoming lessee of the White Sulphur Springs electric light plant. New machinery is being installed.

SALINAS, CAL.—The mayor has appointed the entire council a committee to work with the chamber of commerce on getting work started on the proposed electrolier system.

PALOUSE, WASH.—At a mass meeting the citizens favored a street lighting system, and a committee from the Chamber of Commerce will work with the council in securing the system.

BAKERSFIELD, CAL.—Signatures of property owners on the proposed electrolier system for the business district are being readily secured. The system will mean an outlay of about $30,000.

PHOENIX, ARIZ.—Residents of the Higley section have voted to establish an electrical district. Property owners of the district hope to dispose of bonds for the purpose of providing electricity for that section.

MODESTO, CAL.—An election will be held on January 6, to determine whether or not certain territory shall be organized as a public highway lighting district to be known as the Cross Landing Lighting District of Stanislaus County.

PORT ANGELES, WASH.—The city council has accepted the bid of Oscar P. Dix & Company, bond dealers of Seattle, for the purchase of $25,000 worth of electric utility bonds. The money is to be used for the extension of the light service.

WHITTIER, CAL.—The board of trustees has awarded the contract for reinforced concrete lighting posts together with wires, conduit, etc., to be installed along Philadelphia street from Painter avenue, to the westerly boundary line of the city to John L. Wilson, at $7398.

FERNDALE, CAL.—Manager Jackman of the Western States Gas & Electric Company, in reply to the town's request that the company's lines be extended, has made a proposition for the town to enter into a contract with his company for the installation of an up-to-date street lighting system in all parts of town.

MERCED, CAL.—The city trustees have taken under consideration a plan whereby the city would become local distributor of electric power furnished by the San Joaquin Light & Power Corporation. City Engineer C. D. Martin has been delegated to make an investigation. Upon his report will depend the further action to be taken by the trustees.

PORTLAND, ORE.—An investigation of the financial condition of the Portland Railway, Light & Power Company, with a view of making the results public is to be the purpose of a committee to be appointed as a result of a mass meeting held in the Central Library recently. Commissioner Daly declared that with a municipal lighting plant the cost of electric lighting could be cut materially. He explained that a bond issue would be necessary to provide for the establishment of such a plant, however.

TELEPHONE AND TELEGRAPH.

OXNARD, CAL.—A resolution approving the consolidation of the telephone systems in Oxnard has been adopted by the Board of Trade.

PENDLETON, ORE.—The Pacific Telephone & Telegraph Company plans to completely remodel the telephone system here at a cost of $15,000.

BREMERTON, WASH.—The government will lay a telegraph and telephone cable between the Navy Yard and the U. S. signal office in Seattle.

VANCOUVER, B. C.—The city has secured an option for obtaining all rights for the proposed power plant on Bridge River near Lilloet River, at a cost of $40,000.

BREMERTON, WASH.—The date of opening bids for the construction of a telephone and telegraph line between this place and Keyport has been extended from December 18th to January 10th.

BUTTE, MONT.—Western railways, including the Great Northern, Northern Pacific, Chicago, Burlington & Quincy, Milwaukee, and others, are to join in the construction of 48,000 miles of telegraph lines in the Northwest.

POMONA, CAL.—It is announced that a new building to cost about $50,000, is to be erected here for the Home Telephone Company. Plans are now being prepared. J. F. Blee is engineer.

SAN FRANCISCO, CAL.—An additional floor is to be added to the Bankers' Investment Building at Market and Geary streets. It is understood that the Western Union Telegraph Company is to occupy the entire new floor.

BREMERTON, WASH.—A telegraph and telephone cable will be laid between the navy yard and the U. S. Signal office in Seattle, according to the authorization just received from the navy department. The cable will be run under water.

PHOENIX, ARIZ.—The Western Union Telegraph Company has been given permission by the city commission to construct a conduit from the Arizona-Eastern to the city telegraph office on Central avenue. At present the wires of the Western Union pass through the telephone company's conduit from Jackson street.

TRANSMISSION.

ARBUCKLE, CAL.—The Northern California Power Company is preparing to install a substation here.

LOS ANGELES, CAL.—The city's power bureau has commenced installing poles for the main transmission line from the southern part of the city to the harbor district.

SEATTLE, WASH.—The Electric Heating & Manufacturing Company, 1812 Ninth avenue S., has a permit to repair the manufacturing plant at the same, the additional cost to be $2200. E. J. Rounds Construction Company, Walker Building, are the contractors.

SOUTH PASADENA, CAL.—The Pacific Light & Power Corporation has decided to remove its substation from South Pasadena to another location outside of the city limits. The company asks for a reasonable length of time in which to get established in the new location.

NEWPORT, WASH.—The Northern Idaho & Montana Power Company, represented by Attorney Whelan of Sandpoint has made application for a franchise to build a high-power transmission line along the highway from Newport to and through the town of Dalkena.

ABERDEEN, WASH.—An ordinance introduced provides for granting a franchise for a heating plant for the Finch building, old Livingston building, S. J. Johnston Transfer Company building, post office and others, owned by W. J. Patterson, C. M. Weatherwax and others.

OLYMPIA, WASH.—With 40 representatives of electric light and power companies and 12 representatives of electrical workers unions attending, the public service commission recently began final hearing on the proposed changes to the overhead construction rules affecting these companies.

SEATTLE, WASH.—Plans are to be started shortly by City Architect Daniel Huntington for a building to house an addition to the steam plant on Lake Union, same to be of reinforced concrete and cost $50,000 to $60,000. There is to be a concrete bulkhead and the use of 500 piles.

SEATTLE, WASH.—An ordinance has been passed by the council authorizing issuance of $3,000,000 in utility bonds for purchasing a completed hydroelectric power plant. The board is authorized to advertise for bids for generation of 13,000 kw. of continuous energy capable of generating 25,000 kw. for a period of 5 hours each day.

LEWISTON, IDAHO.—The Washington-Idaho Water, Light & Power Company, recently organized by Liggett, Hichborn & Company, New York and Boston, has purchased the power and irrigation interests of the Lewiston-Clarkston Improvement Company. The plans of the purchasers include the construction of a dam on Snake River that will develop 50,000 h.p. and raise the harbor depth at Lewiston 8 ft.

BANNING, CAL.—The Southern Sierras power line will be extended from Imperial Valley centers to the Colorado River. A contract has been made between the Southern Sierras Company and the Imperial Irrigation District, whereby the Coachella Ice & Electric Company, subsidiary of the Southern Sierras Company, constructs a high tension transmission line from either Niland or El Centro to Hanlon Heading. The cost of the line will be about $200,000.

KLAMATH FALLS, ORE.—Indignant at the action of the city council Monday in voting down the franchise of the Keno Power Company to sell electricity in Klamath Falls, after the question had been submitted to a straw vote of the people and passed by a vote of more than four to one, citizens recently packed the city hall and voiced their feeling in speeches of denunciation. The council had held that after going over the franchise it was found to lack protection of the city's interests and that a new ordinance should be drawn up embodying amendments to this effect.

TRANSPORTATION.

LOS ANGELES, CAL.—Henry M. Densino has applied for a franchise for the construction of a double-track electric railway on Main street from Slauson avenue to Manchester avenue.

SAN FRANCISCO, CAL.—President Jesse Lilienthal of the United Railroads has announced an advance in pay to all its street car platform employes, to become effective on January 1st. The new schedule will mean an advance of more than $100,000 yearly to the pay roll of the corporation.

IRRIGATION.

SUSANVILLE, CAL.—Colonel Carl J. Younger is making preliminary arrangements for starting work in the spring on the construction of the Petes Valley irrigation project. He guarantees to have water ready for distribution in the spring of 1918. The federal authorities have given a right of way over the government land which it is necessary for the ditches to cross.

WASHINGTON, D. C.—The reclamation commission unanimously recommended to Secretary Lane that he urge on Congress the appropriation at this session of $400,000 for the construction of the Warm Springs dam on the Malheur irrigation project and that he further urge the appropriation of another $400,000 to build the storage dam of the Owyhee project in Oregon. Coupled with these recommendations was one favoring an appropriation of $200,000 for the King Hill project in Idaho.

FRESNO, CAL.—For the purpose of receiving the report of Lewis C. Hill, consulting engineer for the government, on the proposed plan to construct a reservoir at Pine Flat on Kings River, a meeting of the committee of thirty of the Kings River Control and Conservation District will be held. If 1,000,000 acres are included in the system the reservoir will cost $8.75 per acre with sand-cement construction and $9.53 per acre with the use of the stone. The irrigation system will take in the present 600,000 acres now under irrigation and 400,000 that will be placed under cultivation.

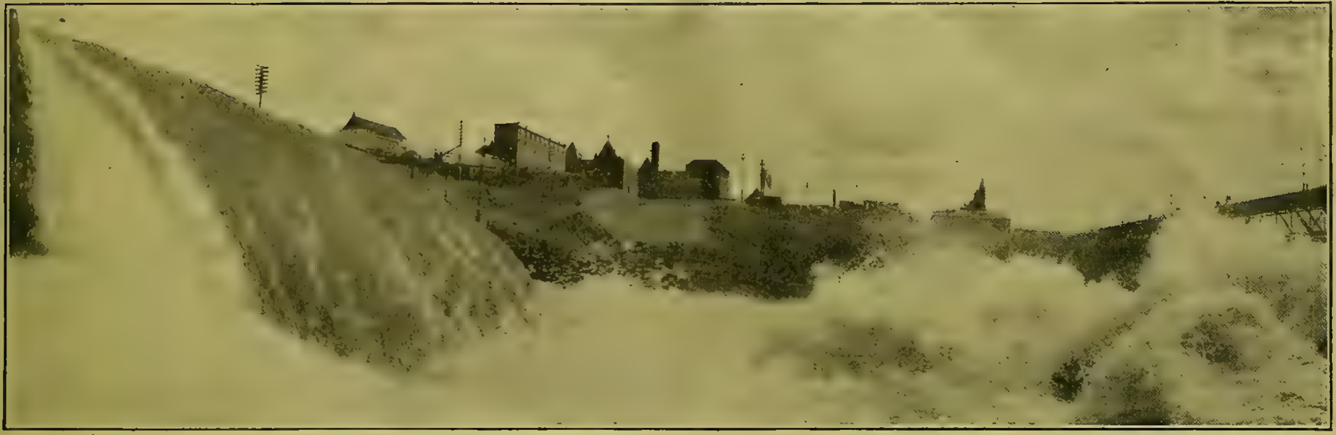
ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

Devoted to the Generation, Distribution and Utilization of Energy

JOURNAL OF ELECTRICITY

VOL. XXXVIII No. 2 SAN FRANCISCO, JANUARY 15, 1917 PER COPY, 25 CENTS



A Striking Instance of Latent Water Power in the West—Lower Spokane Falls, in Washington.

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JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII SAN FRANCISCO, JANUARY 15, 1917 NUMBER 2

THE CONSTANT ANGLE ARCH DAM

BY L. R. JORGENSON.

(The huge Spaulding dam of the Pacific Gas & Electric Company, now raised to a height of 280 ft. above its foundation bottom, is not only of intense interest due to its mammoth proportions, but it also represents a new departure in engineering design by the utilization of the constant angle arch feature. This evolution in design has been created by an engineer of the West and the perusal of the theory involved as set forth in this article will undoubtedly call forth unusual attention from our readers.—The Editor.)

Two arch dams have been built recently in the western part of the United States, to which more than ordinary interest is attached, on account of several new features introduced for the first time in the design. These features accomplish a double purpose. They introduce great economy and they also make it possible for the arch to take the greatest portion of the load acting as an arch even close to the foundation.

So far the greatest objection of engineers to the use of a pure arch dam has been, that as ordinarily built, it cannot deflect enough at and near the bottom, to take the load on the arch. As most of the load at the bottom has to be taken up by sheer action and cantilever action, material sufficient for this purpose must be provided. In the new type of arch the length of the upstream radius decreases at a more or less uniform rate from the crest towards the foundation. In the ordinary type of arch dam this length is kept constant or in case the upstream face is provided with a batter, this length increases from the crest towards the foundation. That this difference in the length of the upstream radii of the two types has an important bearing upon the economies of the design should be easily realized, when it is considered that the thickness of the arch dam section is proportional to the length of the upstream radius at any elevation and that the crown deflection is practically proportional to the square of the length of the upstream radius. Therefore, the smaller the length of the upstream radius, the smaller the required thickness and the arch deflection. This is of especial importance towards the bottom of an arch dam.

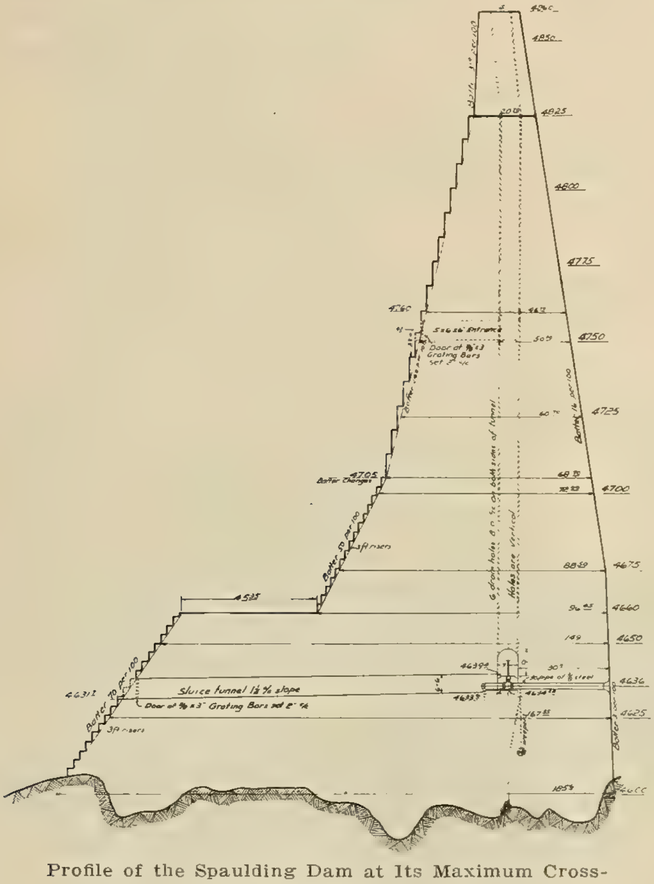
The Giant Spaulding Dam of the Constant Angle Type Recently Raised to 280 ft. Elevation.

Before taking up the description of the particular dams, already referred to, the general calculation of arch dams will be given with especial reference to this new type.

In order to obtain a preliminary dam section for any given dam site the simple formula $t = \frac{P \times R_u}{q}$ (1) can be used for finding the thickness of a sufficient number of arch slices at different elevations, and by superimposing these slices upon each other the dam section can be formed. In this formula **t** equals the thickness of the dam in feet at any given elevation; **P** equals the water pressure in pounds per sq. ft.; **Ru** equals the length of the upstream radius in feet, and **q** equals the

average stress in pounds per square foot of the area of the dam section. See Fig. 1.

From formula (1) it is seen that the thickness and therefore the area of the dam section varies in direct proportion with the radius. The volume of concrete in any arch dam is equal to the area of the section times the length of the mean arch. The length of the mean arch can be expressed as the length of the mean radius times the subtended angle in terms of π or $V = \text{Area} \times R_m \times 2\theta$ (2) where 2θ is the subtended angle.



Profile of the Spaulding Dam at Its Maximum Cross-Section.

The mean radius R_m equals half the width **W** of the span divided by the sine of half the subtended angle.

Fig. 1. Thus $R_m = \dfrac{\frac{1}{2} W}{\sin \theta}$ . . . . (3)

As the area of the section is proportional to the radius (both to **Ru** and **Rm**), formula (2) for the volume of masonry can be expressed thus:

$$V = C \times \frac{(\frac{1}{2} W)^2 \times 2\theta}{\sin^2 \theta} = \frac{K \times \theta}{\sin^2 \theta} \quad \ldots\ldots (4)$$

where **C** and **K** are constants, the latter depending upon the width of the canyon.

According to equation (4) the volume varies with the term $\dfrac{\theta}{\sin^2 \theta}$. The differential coefficient of this term equated to zero gives the minimum for a central angle of 133 deg., which means that any horizontal slice of the dam has the least volume when $2\theta = 133$ deg. In other words the dam contains a minimum amount of material when the central angle is kept 133 deg. at all elevations.

The curve in Fig. 2 shows this graphically. The abscissas represent the central angle 2θ and the ordinates represent the term $\dfrac{\theta}{\sin^2 \theta}$, the latter being proportional to the volume of masonry. In addition to showing the point of maximum economy, this curve also shows that as long as the subtended angle is kept above 110 deg. the variation in the amount of masonry is very small, but below 110 deg. the volume increases rapidly. Most dam sites are narrower at the bottom than they are at the crest elevation, therefore in order to place the material in the dam most economically, it is necessary to change the length of the mean radius of the dam continuously from the bottom to the top corresponding to the change in width of the site, so as to keep the subtended central angle constant. In practice it is seldom possible to keep this angle exactly constant, but one should try to bring practice as close to theory as possible in designing the arch.

To prevent upper portions of the dam from overhanging the lower portion, it will be necessary to have the thickness of the section increase from the crest towards the foundation. The proportional increase in water pressure must therefore be greater than the proportional decrease in length of the upstream radius towards the foundation. The ratio of increase in water pressure is always fixed, and the ratio of decrease in the length of the upstream radius depends upon the slope of the canyon sides. If these slopes are such, that at any intermediate elevation the ratio of decrease in length of the upstream radius has been greater than the ratio of increase in water pressure, a decrease in thickness of the dam at this elevation would result, and the structure would be overhanging, which is impractical. A small overhang at the abutments only is, however, permissible.

Whenever a certain thickness must be provided to prevent too much overhanging, it is most economical to increase the length of the mean radius above that corresponding to a central angle of 133 deg. for the reason that a flat arch requires less material than a more curved one of the same thickness.

In the foregoing, the thickness of different arch slices at different elevations have been determined (from formula 1) as if all the load were taken by the arch and the dam had no gravity action. How safe a dam would result depends primarily upon the unit compression allowed when using formula (1) for finding the thickness at different elevations. This design however would in most cases prove to be weakest in the middle, for the same reason that a long column held at both ends is weakest in the middle and on account of having highest cantilever stresses here. Whenever **t** is small compared with **Ru**, the arch when loaded is practically a long column in compression, and the length of the arch should therefore not be over twenty-five times its thickness if the material is to be highly stressed. It is true that this circular column is supported to some extent along one side, but this added stiffness may be largely offset by the fact that the

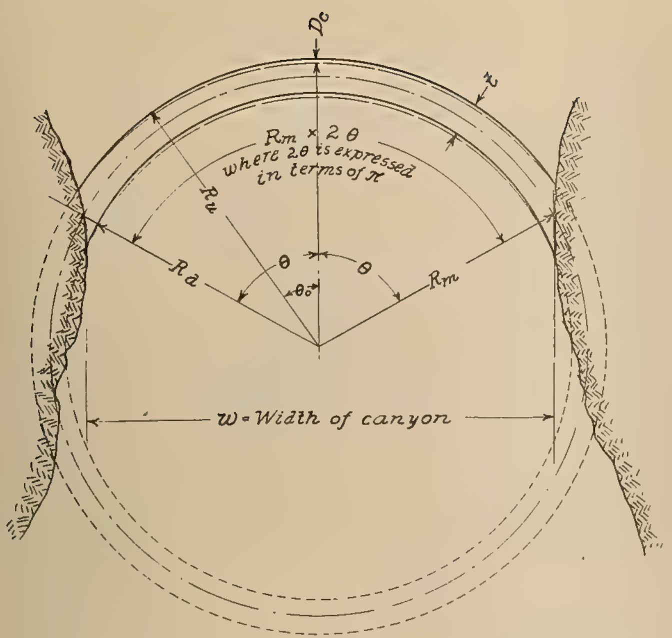


Fig. 1. Fundamental Theory of Stress Action

water may not soak through the upstream face uniformly, that is, the effect of the water pressure would, in all probability, be unsymmetrical about the center line of the dam. On a high comparatively thin arch dam section, the resulting compression due to cantilever action and weight of material above may become excessive near the foundation, requiring some additional material along the down stream face towards the foundation. The thickness of this added material should decrease vertically from a maximum at the foundation to zero at some higher elevation and horizontally from a maximum in the middle, or the point where the deflection is a maximum towards the abutments. The thickening of the dam in the middle to take care of cantilever stress also stiffens the arch materially, considering it as a curved beam. It acts as such to a large extent towards the foundation where **t** is large compared with **Ru**.

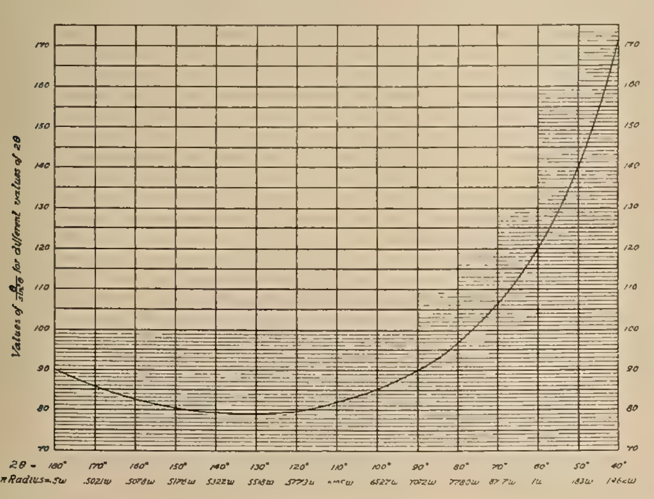


Fig. 2. Curve of Constants for Arch Design.

Before attempting to find what proportion of the load is carried by the arch and what proportion is carried by the cantilever it must be determined how much of the total load is carried by the initial stresses in the arch.

By initial stresses are meant stresses principally due to the weight of the structure and to the water pressure. Therefore these stresses reach their maximum values at or near the foundation and are zero at the crest. They have so far not been much discussed, but are very important and should be taken into consideration, when attempting to find the actual division of load between arch and cantilever. When a body is compressed the dimension in the direction of the compressive force becomes smaller, but in other directions the body swells if free to move (lateral strain).

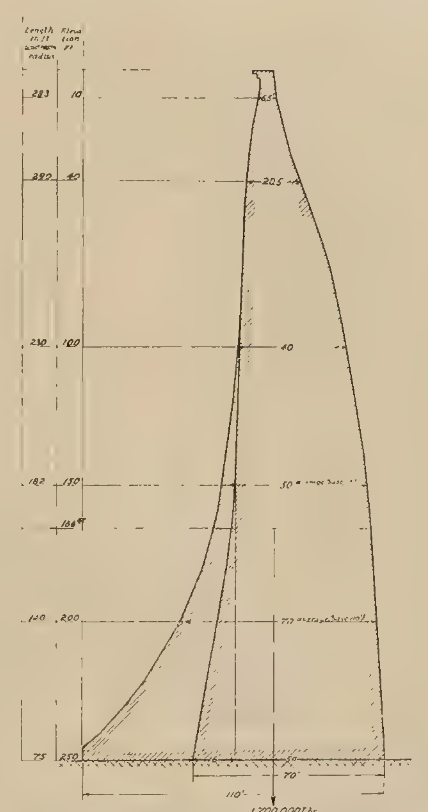
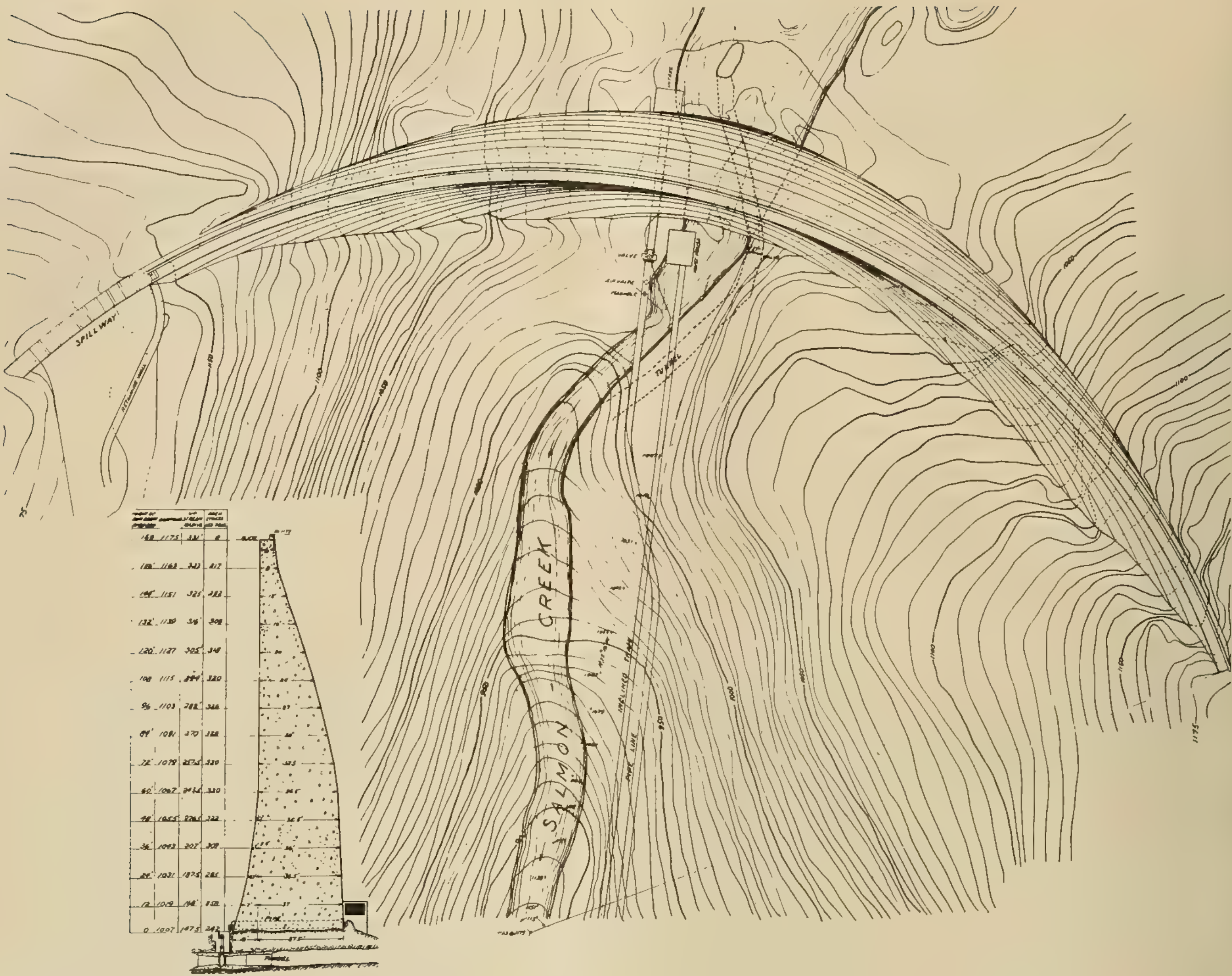


Fig. 3. Profile Section of Dam of 250 ft. Height.

Any horizontal layer of material* will have to sustain compression corresponding to the height of masonry above it and will therefore actually become shorter in a vertical direction and have a tendency to expend horizontally. If the abutments are unyielding the arch may be prevented from actually becoming longer, in which case axial compression is introduced the same as if water pressure acted upon the structure.

If the specific gravity of the concrete for the dam is taken at 2.3 and the height of the dam **H**, then the average vertical pressure can be expressed as $\frac{2.3\,\mathbf{H}}{\mathbf{a}}$ where **a** is the ratio of total height of dam to height of a rectangular wall having the same sectional area

*The ratio of lateral to longitudinal strain for concrete has been taken $1/\mathbf{m} = 1/5$ in the following calculations. Professor C. von Bach has been kind enough to make some tests for the writer to determine **m** for concrete 1:2:3. He found for specimens 45 days old, using between 0.1 and 24 kg/q cm compression, **m** to be 5.3; see also Bach's Elastizitat and Festigkeit 5 Auflage Seite 301. Considering that large stone will be embedded in the concrete in most dams the factor 5 has been used for **m** as probably representing most closely actual conditions.



Constant Angle Dam Constructed on Salmon Creek In Alaska, showing Plan and Profile.

and the same base. The ratio "a" is known as soon as the section is known, and in dam design the section must be more or less determined before final calculation can be made.

The dam section shown in Fig. 3 has an area of 9668 ft., a base width of 70 ft. and a height of 250 ft. The height of masonry column causing the mean vertical pressure is therefore $\dfrac{9668}{70} = 138$ ft. and $\mathbf{a} = \dfrac{250}{138} = 1.81$, making the mean vertical compression upon the foundation in terms of head of water equal $\dfrac{2.3\,\mathbf{H}}{1.81} = 1.27\,\mathbf{H}$ with no water pressure upon the upstream side.

The condition of reservoir full introduces an additional force—the radial water pressure—tending to compress the dam body in a direction perpendicular to the direction of the compressive force due to the weight of the body. At the bottom of the dam this force is equal to **H** in case the water is standing to the crest of the dam. In this case the radial water pressure tends to counteract the swelling of concrete in an up and down stream direction (due to the weight) thereby introducing additional initial axial compression. The total resulting initial axial compression at the foundation of section shown in Fig. 3 is therefore (in terms of head water):

$$1/5 \times (1.27\,\mathbf{H} + \mathbf{H}) = 0.454 \times \mathbf{H} \ldots\ldots (5)$$

where Poisson's ratio has been taken equal 1/5. Mr. H. Ballet was probably the first to point out the necessity of taking Poisson's ratio into consideration when attempting to find the actual stresses in a dam body, Proceedings of the Institute of Civil Engineers, 1909, page 51.

The height of water "h" that this initial axial compression of $0.454 \times \mathbf{H}$ will resist without causing any shortening of the length of the arch at the bottom can be found by using formula (1) thus:

$$\mathbf{h} = 0.454 \times \mathbf{H}\frac{\mathbf{t}}{\mathbf{Ru}} \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

For the narrower section shown in Fig. 3, $\mathbf{t} = 70$ ft. at the base $\mathbf{Ru} = 75$ ft. Substituting these values it

is seen that this section at the very bottom is able to carry $\mathbf{h} = 0.454 \times \mathbf{H} \times \frac{70}{75} = 0.425\ \mathbf{H}$ or 42.5 per cent of the total head of water as an arch before any shortening in the length of the arch occurs.

The initial axial compression holds in equilibrium the stresses due to 42.5 per cent of the total head at the bottom the remaining 57.5 per cent of the load will divide between cantilever arch and curved beam action in proportion to their relative carrying capacity.

By analyzing equation (6) it is seen that by simply varying **t** or **Ru** or both, the designer can utilize more or less of the initial stress to carry the load. If the base thickness in Fig. 3 is increased from 70 ft. to 110 ft. and the thickness increased correspondingly at higher elevations, the initial stresses will be able to support at the foundation $0.4 \times \mathbf{H} \times \frac{110}{75}$

$\mathbf{h} = 0.585 \times \mathbf{H}$ or 58.5 per cent of the total water pressure before any shortening in the length of the arch occurs and before additional axial compression is introduced.

When the arch, however, becomes very thick in comparison with its length, the load is carried more by curved beam than by ordinary arch action.

The dam shown in Fig. 3 was designed with varying radii to keep the central angle of the arch as nearly constant as possible at all elevations. For comparison, a section is shown in Fig. 4 using the same unit compression except where the section is wider than a gravity section near the foundation and the same upstream face batter, but a single common center as ordinarily used for both upstream and downstream faces. For this section the length of the upstream radius is also variable, but it increases towards the bottom and reaches here a value of 322 ft., see tables of lengths of the respective figure. The initial stresses in this dam will resist 20 per cent of the head of the water at the bottom. It is therefore easily seen that the constant angle arch is much more effective in utilizing the initial stresses to carry the load, than is the ordinary arch dam struck from a single center. If a gravity section is insisted upon for the arch, but the central angle kept as near constant as practicable it will be possible for the gravity section to take up the greater part of the load acting as an arch and curved beam. The factor of safety has thereby been largely increased.

For finding the arch deflection the following formula has been used:

$$\mathrm{D\,c} = \frac{\mathbf{C\,C_c} \times \mathbf{P_1}\ (\text{upstream radius})^2}{\text{Ext.}} \quad \ldots\ldots\ldots (7)$$

where $\mathbf{P_1} = \mathbf{P} \times \frac{\mathrm{Ru}}{\mathrm{Rm}}$ and $\mathbf{C\,C_c}$ is a factor which takes the curved beam action* into consideration and can be directly found from Fig. 5. **E** is the modulus of elasticity and **t** is the thickness.

Formula (7) has been used for finding the deflection curves **A** and **B** (Fig. 6) of the two sections Fig. 3 (base 110 ft.) and Fig. 4.

Formula 6 has been used for correcting these curves **A** and **B** to take the effect of lateral strain into consideration. These curves represent the deflection of the two arches assuming they are free to move at the foundation. They are plotted to show how evenly the deflection, curve **A**, slants from a maximum near the top to nearly nothing at the bottom in the constant angle arch type Fig. 3 and how little the slant curve **B** amounts to in the ordinary type of arch dam Fig. 4. These curves also show very plainly that from the common arch type much arch action towards the bottom cannot be expected, cantilever and beam action must take the load since no such deflection as 0.2624" could be possible at the point where the arch is fastened to the rock foundation. The constant angle arch type for this particular site requiring only 0.0083" deflection, 31.5 times less to support the same load will take most of the load upon itself acting as an arch.

The foregoing method of calculation does not hold true for carelessly constructed dams. On such structures the initial stress can not be expected to assist the stability of the arch. For carefully constructed dams, the theory should hold true, and the possibility even exists of constructing the dam such that the actual stress will be more uniformly distributed than the formulas would indicate. This can be accomplished by using many plumstones in the concrete along the upstream face and few or none along the downstream face, thereby making the shrinkage due to settling less along the upstream face, and also making the modulus of elasticity higher along this face, both these conditions tending to effect a transfer of stresses from the downstream face towards the upstream face, and also tending to lessen the maximum cantilever compression at the downstream toe.

The fact that the water load is not thrown on the structure in an instant, also tends to affect a more uniform distribution of the stresses. Generally weeks or months are required to fill up a reservoir, and during this time interval the modulus of elasticity of the concrete has had time to adjust itself according to the different amount of stress thrown on different portions. Due to the action of the time factor*—for concrete only,—parts highly stressed, such as the toe of high dams, deform much more than in proportion to the load carried, and therefore, as the concrete yields, load is transferred to some other place of lower stress, thereby relieving the most highly stressed part. An important arch dam should not be closed during the hottest season, but should be built up in alternate sections and closed during the colder part of the season, and it should not be built too fast. Careful construction is more important than the use of low stresses in the design.

SHORT JOURNEYS IN PACIFIC LANDS

(South America constantly appeals to engineers of the West as a possible field of future activity. Descriptions of the country and the customs of the people are of great practical aid to engineers when making journeys into countries bordering the Pacific. Below may be found some of the interesting experiences encountered by an American engineer who was formerly engaged in hydroelectric installation in Peru.—The Editor.)

A Native Peruvian Town, at Elevation 13,500 ft.

The Highest Railroad in the World, at Elevation 15,685 ft.

Water Diverted from Amazon for Hydroelectric Power.

AN AMERICAN ENGINEER'S EXPERIENCES IN PERU.

The water of the Yauli River was diverted about one mile below the little town of Pachachaca by means of a dam and carried along the hillside in canals or through tunnels and pipe lines to Oroya, where the power house is built near the junction of the Mantaro River and the Yauli River. The first installation in this power house consisted of three 3000 kilowatt electric generators or a total of 12,000 h.p. This power is transmitted to the company's mines located on both sides of the power house, and also to the copper smelter, where electric motors substitute the former steam equipment. The total fall or head of water at the power house is 730 ft., and the maximum distance from the plant to which power is transmitted is 100 miles, the operating voltage being 50,000.

In traveling along these rivers I had occasion to become quite familiar with the country. The hills contain, or are supposed to contain many minerals, and some of them are being taken out by big companies. This is not a proposition for a poor man to tackle, as it requires large investments before any returns are possible, larger than in other places on account of the inaccessibility of location.

Agriculture is evidently a poor business on account of the high altitude, where only enough wild grass can grow to support sheep, mules, llamas and a few other native animals. I do not understand why the Indians living up on the hills do not move lower down in the valleys where they can raise something. They seem, however, to be able to just make an existence with very little effort, and evidently that is satisfactory to them. The many ruins of what were former cities and towns located on the very top of the mountains were an indication that the country was much more populated in these places in former years. Also the fact that even the hillsides had been terraced off and farmed, and some of them are being farmed today, is very interesting. It is incomprehensible how the people were supplied with water on the very top of the mountains.

I was astonished to find that ordinary animals, such as pigs, horses, etc., do not multiply up in this high altitude. While they can live there, they lose the power of propagation and a new supply must be brought up from below from time to time. There were no fish in any of the streams, probably due to the absence of insect life. The chickens lay eggs but they do not hatch. All this goes to show that it is not only mankind that the atmosphere affects. The absence of trees or growth of any description makes the place as desolate looking as a desert, and if it was not for the minerals in the hills, would not have any attraction.

The surveying of the hydraulic canal was very much facilitated by the absence of vegetation, there being nothing to obscure the views in any direction. The river below and the snow-clad mountains above were always in sight. As we went ahead we moved our camp which consisted of two tents, necessary food, blankets, etc. The cooking was done by an Indian, and although we had good oil stoves and oil and coal along, he kept on using the kind of fuel he was accustomed to, dried manure. He traded this from Indians in the neighborhood for the coal and oil we had along. The dwellings of the Indians along the stretches we traveled were primitive and I do not see how they managed to keep warm as the temperature is low considering this place is but 12 deg. south of the equator. It generally freezes at night and in the day time the thermometer seldom gets much above 60 deg. fahrenheit.

I stayed one day and night with a family in one of those casa's because I had to. Missing an ore train which we were supposed to stop and ride on to a certain place, the party had no choice of what to do for the night as we had no tent and it is too cold and dangerous to sleep out in the open at that altitude. There were only Indians around so we put up in an Indian mansion for the night. The family consisted of a couple of men and a couple or women, some "tame" pigs and chickens. One of the ladies prepared the dinner, which consisted chiefly of a piece of sheep

meat which had been laying outside on the rocks to dry for quite a while. It made a hit with our Indian cook and our guide, also an Indian. I was well satisfied with a few raw eggs and some Lima Pilsner. Most of the family slept on the floor, the solid terra firma, of course. I was fortunate enough to get something that resembled a bed to lay on and was quite comfortable. Very luckily, all insect life is absent in this altitude.

Before a waterpower plant can be built a permit to divert and use the water must be obtained from the government. In this respect the Peruvian government is liberal, feeling that everyone who is willing to invest money in undertakings that will build up the country ought to be encouraged in trying to do so.

NOTATIONS FOR TELEPHONE INSTALLATIONS IN CHINA.

The police headquarters at Chungking recently received instructions from the Co-Director of Military Affairs of Szechuen Province to establish a small telephone system to connect the various government offices and police stations in this city. This system is being established to facilitate the transaction of official business and is not intended for the use of the public. Fifty telephones and their accessories have been ordered through a local firm from Shanghai. The instruments are said to be British and to cost 120 taels (about $91 United States currency), each. The service has been offered to the local consulates.

The regulations governing the installing of telephones prescribe that subscribers must deposit a cash bond of $50 Mexican (about $27 United States currency), which will be returned when the telephone is removed, and pay a monthly fee of $6 Mexican. The shortest term for which a phone will be installed is six months. This system is under the management of the police headquarters of Chungking. It has been arranged between the police headquarters and the telegraph administration that in the event of a service for the use of the general public being established, this system will be purchased by that administration.

The installation and operation of telephone services is a government enterprise and is reserved to the Ministry of Communications.

THE ELECTRICAL MAN'S RESPONSIBILITY TO HIS COUNTRY.

H. M. Byllesby addressed the Electric Club—Jovian League of Chicago, at its weekly luncheon December 28th, at the Hotel Sherman, on the above subject. A large audience applauded his remarks on the need of preparedness, in the course of which he said:

"If the perils to our country, now so ominously emerging, are overcome it will be because we citizens calmly and with spiritual uplift immediately consecrate ourselves to that service to the state which each of us are best able to discharge. In this rising to the defense of our beloved country, which has showered so many opportunities upon us, the electrical man must be, and naturally will be, a factor of the first importance. The electrical man has had an experience of unique value which he can place at the disposal of his country.

RECENT TESTS BY BUREAU OF STANDARDS.

Among the tests conducted recently by the United States Bureau of Standards as aids to the development of industrial methods were series relating to the construction of concrete columns and the production of insulating material.

Three tests were made of a special commercial insulating material to determine its fire-resisting properties. The material submitted by the manufacturers was intended for use in a number of instances to replace wood. The test specimens were about 18 by 18 inches and 6 inches thick. They were placed in a furnace as a panel, one of the larger faces being exposed to the heat of the furnace and the other to the atmosphere. Upon being heated to 950 deg. in 30 minutes and held at that temperature for four hours it was found that the temperature at a distance of 1½ inches from the heat-exposed surface was about 240 deg. C. At a depth of 5½ inches from the heat-exposed surface 66 deg. was the highest temperature recorded. One of the blocks after having been subjected to this heat for the period mentioned was quenched with water. The damage to the specimen that was quenched was found to be less than to an unquenched specimen. This is explained by the fact that the blocks contained considerable organic matter which tended to be disintegrated by the heat transmitted very slowly from the heated surface, even after the flame was removed from it.

The series of tests of concrete columns was partly in the nature of an investigation and partly in the nature of routine testing. These are the first columns of their kind to be tested in this country. The unique feature is a hollow cast-iron core. This is surrounded by concrete, reinforced with both spiral and vertical reinforcing. Such a column may be made very cheaply. Not many results have yet been obtained, but the tests are still in progress. It would appear, however, that the load which these columns can sustain is considerably in excess of that which can be borne by the ordinary reinforced concrete column of an equivalent cross section.

A NEW BOOK OF GEOGRAPHIC POSITIONS.

Bulletin 644 part E, just published by the United States Geological Survey of the Department of the Interior, gives latitudes and longitudes of primary traverse stations in Illinois, Wisconsin, Minnesota, North Dakota and South Dakota, for 1913-1915, inclusive.

This publication gives descriptions and geographic positions of 1870 points, such as road crossings and section and township corners, some of which are permanently marked by iron posts, 4 ft. in length, set firmly in the ground.

Such data as these are essential to map makers and are determined by the Geological Survey for the control of its topographic maps. The positions and distances given may also be used with advantage by land or mine surveyors for checking their work.

A copy of the bulletin will be sent post free to any one who is directly interested and will address a request to the Director of the Survey at Washington, D. C.

DISCUSSION ON ELECTRIC LOGGING.

Sir:—The paper on Electric vs. Steam Logging, read by Mr. W. D. Peaslee before the recent Pacific Coast Logging Congress at Portland, and printed in the November 18, 1916, issue of the Journal, has brought forth discussion among engineers of long practical experience in the Northwest.

This discussion is not offered in any spirit of criticism, but only for the purpose of getting before the readers of the Journal the views of a great many engineers who have not been convinced, as yet, that electric logging has been developed and perfected to such a state that on a cost basis it can compete with steam under the inherent conditions surrounding fir timber logging of the Northwest.

As Mr. Peaslee states in the opening paragraph of his paper that, "The first and most important final answer to the question as to which logging machine is most suited for a particular duty, is represented by the dollar mark." The following discussion will endeavor to point out wherein many engineers and loggers familiar with logging conditions in the Northwest do not agree with him.

On page 391 it is sstated "The following summary of costs per donkey is based on an installation of five machines."

Building 35 per cent of proportionate building cost	$1050.00
Power station on same basis	5330.00
Total	$6380.00

It would be necessary to furnish at least 350 kw. of capacity for each logging donkey and figuring at $65 per kw. for power station equipment and buildings, we have (for each one) $22,750 instead of $6380 as given by Mr. Peaslee. We understand that Mr. Peaslee's figures are for one donkey plant equipment instead of five as stated in his paper.

The next item:

Transmission line	$ 3,200.00
The minimum average length of transmission lines taking in consideration new and old camps, would be be a conservative estimate 10 mies and at a cost of	1,000.00
Per mile we get	10,000.00

Allowing Mr. Peaslee's price of $6550 for transformers and cables, we have a total cost of $39,300 instead of $16,130, based upon the installation of one logging donkey, instead of five.

Mr. Peaslee states that power costs are based upon 1.5 cents per kw. hour. Now let us figure out what the power company will receive when it offers power at this rate to a logging company.

If the donkey ran 30 days a month of 24 hours each at 1.5 cents $=$ $10.20 per month and 12 months of the year $=$ $122.40 per year per kw.

Logging donkeys, however, do not operate continuously, but vary intermittently. Average conditions are as follows:

10 hours per day $= 5/12$ of a day.
25 days per month $= 5/6$ of a month.
9 months per year $= 3/4$ of a year.

Therefore we have:

$25/96 \times$ $122.40 $=$ $31.87 per year per kw. at 100 per cent power factor.

Thus, if the load factor equals one-third, the final revenue the power company will derive on peak load $10.62 per kw.

This does not appear as a very attractive proposition from a power company's standpoint and it is consequently very doubtful if power could be purchased for 1.5 cents per kw.-hr. for logging purposes under average conditions. Also the hard duty imposed upon the transmission line from a load of this character is not attractive even on general principles.

On page 392, in the fourth paragraph it is stated that an electric donkey will handle 25 per cent more logs in a given time than the steam donkey.

As there is no electric logging of fir timber being carried on at this date, any assumption of this kind is not based upon actual data and should be regarded as purely speculative.

On page 393 Mr. Peaslee states that cables might be bought on a guaranteed mileage basis, providing it was not strained beyond a certain point during the period of operation.

Because the operating conditions surrounding each "set-up" presents such a variation of rigging and soil conditions for abrasion of the cables, no cable manufacturer could sell cable on this basis.

If a cable was subjected to sharp bends or turns through blocks, it would have its life shortened materially no matter if it were not "strained."

Also, if the ground was sandy or rocky and badly broken up, the abrasion would be increased.

When logs are cut, they must be gotten out or "yarded," regardless of cables and safety devices.

Consequently it would be a very exceptional case when it would be practical to always operate without straining them.

On page 393 Mr. Peaslee says, "the possibility of electric shock from the donkey is very remote and entirely negligible, if all metal parts of the equipment are thoroughly grounded.

"Thorough grounding" under normal conditions would mean making the ground at a water source and would have to be of a very substantial and absolute nature.

During the dry season this might mean a ground line 1000 to 2000 ft. long, in order to reach a place with sufficient moisture for a permanent ground.

Also under logging conditions the ground wire would be always subject to all manner of disturbances—such as breaks from falling timber, etc. F. D. WEBER.

PETROLEUM IN CENTRAL WYOMING.

The petroleum resources of central Wyoming have engaged the attention of many since the days of Captain Bonneville's travels in the last century, when he described for the first time some of the tar springs of that region. Definite information as to the situation of the rock folds that are favorable to the accumulation of oil in this region is given in a report just issued by the U. S. Geological Survey, Department of the Interior. This report contains an account of the oil-bearing formations in central Wyoming, and points out the formations most likely to contain petroleum, such as the Frontier, with its important Wall Creek and Peay sandstone members, which are the productive sands in the most noted commercial oil fields of Wyoming. The report describes more than 20 anticlinal folds and notes whether the prospects that they may contain petroleum are favorable or unfavorable.

Large sums have been spent in prospecting in this region, but much of it has been wasted in unlikely places, and it is believed that wells properly located would perhaps yield oil in commercial quantities. The places where the most promising oil sands are concealed in anticlinal folds are pointed out in the final discussion.

A copy of Bulletin 641-I, entitled "Anticlines in Central Wyoming," by C. J. Hares, will be sent free of charge on application to the Director of the U. S. Geological Survey, Washington, D. C.

BETTER OFFICE METHODS

(The telephone has grown to be indispensable in modern business and engineering practice. Herein are set forth some excellent pointers that every business and engineering firm may well ponder over in the selection of private operators. The author is Division Superintendent of Traffic for the Pacific Telephone & Telegraph Company at Portland, Oregon, and presented this paper before the recent bi-monthly luncheon of the joint local sections of the A. I. E. E. and N. E. L. A. with the Oregon Society of Engineers at Portland.—The Editor.)

Operating Room. Retiring Room. Lunch Room.

THE TELEPHONE OPERATOR AND HER WORK.

BY J. H. CORCORAN.

The subject I have elected to discuss is that of the Telephone Operator and Her Work, because, while associated with telephone companies for many years, I have been directly associated with the work of improving central office operating practices and methods, and the training and supervision of central office operators, for the past eight years.

As you are aware, the telephone and the telephone switchboard were not invented simultaneously. The first telephone consisted only of what we now term the "receiver," and when used, these were connected in pairs, that is, one receiver was placed on one end of the line and another receiver on the other end.

It became apparent with the additions to the private lines that some sort of a switching device was required so that one line could be connected with another. Telephone history, I believe, credits a Mr. Holmes, Jr., of Boston, with putting in use the first telephone switchboard. Mr. Holmes' father operated a burglar alarm system which had wires to the principal banks in the city, and young Holmes found that by putting a telephone on each of these circuits and tying the terminals of the burglar alarm circuits together with a piece of wire, the telephones would be connected. This, while a very crude arrangement, was really the birth of a new idea in the business world.

In a short time it was found that the switchboard used by the telegraph companies was adaptable for telephone use, and the first commercial switchboards were of this type. The usual plan of operation for the central office then was this: A switchboard of the telegraph type was built on one side of the room. On the other side of the room registers containing paper tape were placed. On the subscriber's premises was placed a telephone consisting of a receiver, a vibrating bell and a call box of the same type then and now used by messenger companies. To the subscriber's premises were built two lines; one, his telephone line, and the other, the circuit on which the call box was located, there being many of these call boxes on one circuit. To signal the central office, the subscriber pulled the lever on the call box. This caused the call to be recorded on the paper tape at the central office. A boy would read the record on the paper tape and call across the room to another boy to answer a particular subscriber. The boy operator would then take a cord and plug into the jack of this subscriber, and after obtaining the number would establish connection on the board.

In the larger offices, (and you must remember that there was no multiple in those days) the switchboards were from twenty-five to thirty feet long, and the cords were correspondingly as long. They were termed the "Cord and Reel" in those days, as the cord wound up on a reel by spring pressure.

It is certain that when several calls were being received about the same time, what with the calling of numbers across the room and the boys racing madly from one end of the board to another to complete these connections, that the central office was not a quiet restful place.

As the systems grew, the confusion became greater and greater, but in the meantime developments were being made in the switchboard; the carbon transmitter was being brought into use; and gradually the loud-voiced boy was being replaced by the soft-voiced, deft-fingered girl. It is true that in these earlier days, the girl operators did not receive any particular training. The boards were comparatively simple, and the calls were few. However, as the system grew, the need of training operators carefully for the work was apparent.

The telephone companies in the larger cities today provide well-equipped training schools for their

operating forces. An applicant for a position as operator has her eyesight tested, her enunciation noted, must have a good grammar school education, and must impress the school principal as being a person who will not discredit other members of the operating force.

After a girl has been accepted as a student—and I wish to call to your attention that in this city of Portland only one in six of all applicants are accepted in the operating school, and it must not be understood that every applicant graduates from the operating school, because even after acceptance, it may be found that some feature or mannerism renders the girl unfitted for telephone work—after a girl has been accepted as a student, she is placed in our training school for a four weeks' instruction in the handling of telephone calls. Remember that this four weeks is simply a preliminary training for the student. The schools are provided with competent instructors, are equipped with individual desks, with a standard multiple switchboard, and special apparatus so that the instructors can originate calls which the students will answer, and complete in the multiple board. A course of study is provided so that during eight hours of each working day of these four weeks the student is either engaged in handling calls originated by the instructors, is reading the explanation and instruction covering the handling of calls from her study books, or in class is listening to an instructor going over the details of the lessons they have been studying.

When the student graduates from the school—and she is not permitted to graduate until she is letter-perfect in the handling of a call under all conditions, and there are many, many conditions which surround a call which the operator must learn—she is sent to a central office. At the central office she is still not permitted to complete calls from the public, but listens in with an experienced operator and one who has been selected for this purpose, due to her particular fitness for assisting the newer girls. After she has been in the central office a sufficient number of days to permit her to become accustomed to her surroundings, she is permitted to answer calls from subscribers, but still under the care of a senior operator who is listening in with her. Her progress is rapid from this time on, and in a comparatively short time she is permitted to answer calls alone. The newer operators, however, are kept at the less busy positions, as it can be understood that the rapidity with which they can handle connections safely and accurately is controlled by their experience. At the end of eighteen months, the operator may be considered as experienced.

It will be seen, therefore, that the telephone companies, in order to render the most efficient service possible to the subscriber, have kept continually at the developing of the switchboard in order to reduce the time period required to establish connection, and in step with this, have trained their operators in a manner so that the public does not have to bear the burden of inexperience, but this latter is removed, as far as is possible, at the training schools.

In the City of Portland, we have 650 operators. It must be remembered that each one of these 650 operators are young women who have been selected for their work. As I have said before, only one applicant in six is accepted for the work, so that here we have a force which has been selected from over 4000 applicants.

It must be seen therefore that in the telephone work we have the highest type of young woman that is in the business world today. Her clients, however, demand exacting attention. They will not stand in line as they do in the theater, or the store, or the barber shop, and await their turn, but demand instant attention. They are in a hurry—that is the reason they are using the telephone—and every second seems a minute long, and any apparent neglect or wrong number is taken as a personal affront by the subscriber. As a matter of fact, the telephone girl in America today has become so efficient that we expect her to be a paragon of perfection. Such complaints as she may get she bears patiently, as she knows very frequently that the wrong number complained of really was called by a subscriber who made a mistake and learned it when the called subscriber answered, but would not acknowledge it and let the called subscriber assume the operator was at fault.

A great deal of her trouble is due to the improper method of talking into telephone transmitters. In the old days, when they had a receiver which they used as both a receiver and transmitter, it is said the companies found it necessary to furnish the subscribers with a notice reading: "Do not try to talk with your ear or listen with your mouth." Today many of the subscribers properly listen with their ears, but they do not talk with the mouths anywhere near the transmitter. The result is that the operator frequently has to ask a second time for the number. If you want to be considered a friend of the central office operator, do what you can to have the public talk into the telephone, and not at it.

We who associate with the central office operator, admire and respect her. We know of her courage and you have frequently read, no doubt, in the public press, of some telephone operator who has stuck by her post in the face of an advancing flood, or other calamity, warning her subscribers of the danger. I have been in a central office in a large city where the operating rooms were covered by an immense glass skylight. When the building adjoining took fire, the flames went across the glass skylight, cracking the glass and filling the room with smoke, but the operators stuck to their post, of attempting to handle the tremendous number of calls occasioned by the fire which was quite a spectacular one. I have been in a tall building in an operating room when the city was shaken by an earthquake. My inclination was to run run for the door. The operators, however, remained at the board, a little pale, perhaps, but ready for the great number of calls which they knew would follow the shake.

During last February's sleet storm, when transportation was at a standstill in the City of Portland, some of our operators waded through snow several miles to get to the central office to help in handling the heavy traffic they knew would have to be handled at such a time. They knew that they would not be criticised for failing to report to the office at such a

time, but they wanted to do their part in giving the public service.

Can you wonder that I, who know what these young women are doing every day, appreciate the opportunity of telling you the part that the telephone operator plays in the telephone world? And this reminds me of another phase of telephone operating which is not in the central office, and over which the telephone company has no control, and that is the operating of private branch exchanges:

The private branch exchange operator in many business houses, and probably in most, guards the entrance through which the greater volume of the business of the firm is done. Notwithstanding the importance of the position, however, I have known girls who were rejected by the telephone company as not fitted for telephone work, being placed in a private exchange position simply on the statement that she had at some time been engaged in telephone work, or had at some time been engaged in private branch exchange work. The young lady, in applying for the work, is not intentionally misrepresenting, but, as a matter of fact, does not know the requirements of the position. This is a matter strictly up to the employer, and he should use the same care in selecting a person for this position that he would for any other responsible position in his business.

During the late night or early morning hours, when a big fire visits a city, you will find telephone operators hastening to the nearest central office to help out the night operators. They do this of their own initiative, as we could not and would not ask them to do it, but it does indicate the general desire of the operators to do their level best to serve the public.

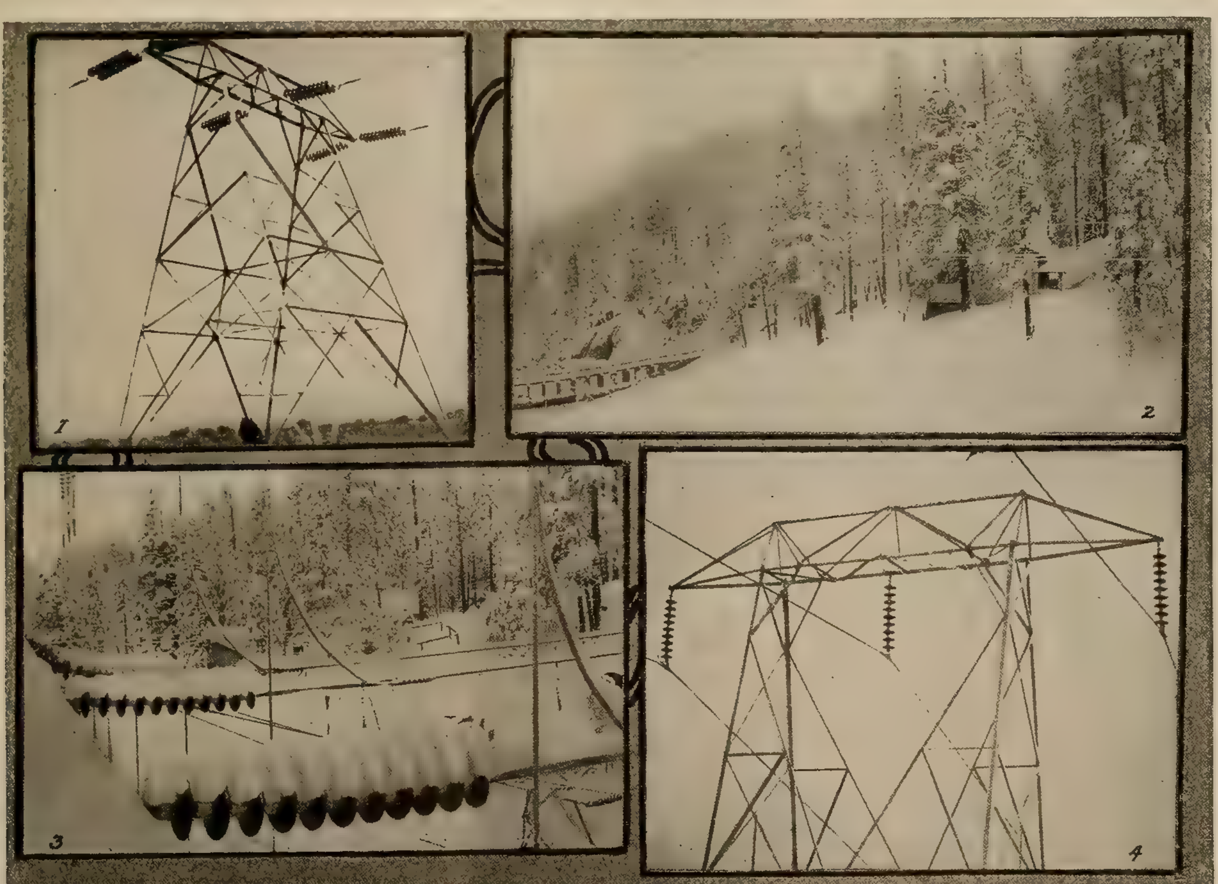
I want you to think over this: Is the private branch exchange operator at your place of business trained for her work? Have you given as much attention to training her to handle your work as the telephone company has given to the training of its central office operators to handle your work?

SNOW SCENES IN TRANSMISSION SYSTEMS OF THE HIGH SIERRAS.

The Pacific Light & Power Corporation has the distinction of possessing one of the highest voltage transmission systems in existence represented by its Big Creek intallation which generates its energy in the high Sierras and transmits it at a voltage of one hundred and seventy-five thousand to Los Angeles, a distance of two hundred and seventy-five miles.

The Bulletin published by that corporation has a most interesting description of snow scenes in the high Sierras in its recent number. Below may be found some views which tell to the eye most emphatically the story of the burden added to a transmission system that develops its energy in the snow-clad Sierras.

The Pacific Light & Power Corporation is to be merged with the Southern California Edison Company as soon as official permission from the California Railroad Commission may be obtained, thus forming the fourth largest central station organization in the United States.



Big Creek Transmission Line.

1. Anchor Tower. 2. Winter Scene—Cascada. 3. Snow on Strain Insulator. 4. Standard Tower.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING.

(A working knowledge of the laws of underground supply for water used in irrigation pumping is proving indispensable as the installation of electric pumps becomes more intense in the agricultural districts of the West. Here is recently compiled material which sets forth a new source of underground supply due to seepage from adjacent projects. A number of power companies and engineers of the West are co-operating with the author in the gathering of this important data.—The Editor.)

IRRIGATION SEEPAGE AS A SOURCE OF PUMPING SUPPLY.

The Borel Canal Concrete Lining Lessens Seepage.

THERE were experiments made near Riverside, California, in 1908, which are given in bulletin No. 203 of the official experiment station of the U. S. Department of Agriculture. On a sandy loam soil it was found that 23 per cent of a 6½ in. irrigation was not accounted for in the upper 6 ft. of soil. This water was applied in furrows and the evaporation loss for the time between samples would be relatively small.

Water becomes distributed more quickly in sandy soils than in those of closer texture. The total moisture holding capacity of light soils is also less. On the sandy soils of the Umatilla Experiment Farm, in Oregon, as given in their report for 1914, it was found that the upper 4 ft. of soil retained no more water from a 5 or a 10 in. irrigation than from one of 2.5 in. depth. In experiments on the Minidoka project in Idaho, given in the Reclamation Record for April, 1916, it was found that sandy and sandy loam soils were only able to retain from an irrigation the equivalent of 4 in. depth of water in the upper 5 ft. of soil.

The results of these and various other investigations of the amount of water retained by soils were summarized by O. W. Israelson in a paper before the International Irrigation Congress at Sacramento in 1915. These gave an average retention in 6 ft. of soil of 5.3 in. of water for light soils, 4.0 in. for medium soils and 3.5 in. for heavy soils. Normally the water holding capacity for the medium and heavy soils is greater than for light soils, the smaller amounts shown are due to the greater difficulty in getting the water into these soils due to their closer texture. Gravelly soils would have lower moisture capacity depending upon the proportion of gravel present. Gravel has the effect of reducing the volume of fine soil in a given depth.

These results indicate that the water held by soils will not exceed one inch of water per foot depth of soil except under unusual conditions. If the plant roots can use the moisture in the soil to a depth of six feet, any irrigation in excess of 6 in. would be lost by deep percolation. If the soil is irrigated before becoming relatively dry, the amount which can be retained would be reduced.

In heavy soils, the movement of moisture, through the soil is slower and a less depth per irrigation is usually applied. For this reason the amount of deep percolation loss is less.

The amount of water used per irrigation varies widely. On light soils it may be difficult to cover the fields without using more water than is required by the soil. With flooding methods of application this is particularly true. The average depth used per irrigation in extensive measurements made in Idaho from 1910-1913 was 6 in. on grain and 7 in. on alfalfa. Most of the soils were of relatively high water holding capacity. Individual irrigations varied quite widely and it is probable that the average deep percolation loss was at least 1 or 2 in. depth of water per irrigation. That such losses are occurring there is instanced by the rise of ground water which has taken place in the vicinity of Twin Falls since irrigation has been introduced. Investigations have shown the rise of ground water to have been as high as 25 ft. in some years, in 1914 it was 9 ft.

Measurements of the water used on alfalfa in 81 fields in the Sacramento Valley were made in 1913 and 1914, the results of which have been published in bulletin 1 of the State Engineering Department. The average depth per irrigation was about 8 in. The largest average for any locality was 1.35 ft. or 16 in. depth for 9 fields near Los Molinos in 1913, the smallest 3 in. for very heavy soils near Willows in 1914. These figures indicate that there is a large proportion of the water applied to these soils which was not retained but which passed to lower depths and joined the ground water.

If land is to be flooded without using excess depths per irrigation the method of applying the water must be such that the land can be covered quickly. Six inches depth of water will usually be absorbed by

Typical Canal Design for Citrus Fruits.

sandy soils in less than one hour. With very light soils it may be difficult to flood over the surface without having more than six inches depth absorbed. For the heavier soils the time will increase, for loams water should not usually be applied to a check for over two hours. With heavy soils the time is limited more by the length of time the crop can stand irrigation without scalding than by the rate of absorption.

The same soil moisture properties apply to water used under pumping plants as to that secured from gravity supplies. Owing to its generally greater cost, the average practice with water which has been pumped is of a higher type with less carelessness in handling. If too large a depth is applied in a single irrigation from a small pumping plant the excess will percolate downward to rejoin the water table from which it was pumped unless impervious strata occur in the soil.

When the conditions of general practice are reviewed in the light of the data given on the moisture holding capacity of soils the conclusion seems warranted that probably an average of at least 20 to 30 per cent of the water applied to crops by flooding methods percolate beyond the reach of plant roots. Where furrows are used the amount applied is generally less but there may be considerable loss from deep percolation under the furrows. For porous soils carelessly irrigated the deep percolation loss may exceed one-half the amount used.

In general the surface and underground waters of any stream basin are relatively distinct from other basins. This may not be the case in the San Joaquin and Sacramento basins where the underground waters may be continuous and not directly dependent entirely on local tributaries.

Any deep percolation or canal seepage loss in one portion of a stream system generally contributes to the supply lower down on the same stream. This may occur only as a rise in the ground water. It more usually occurs as a return flow to the lower stream channel. There are a number of Western streams from which, at different points, the entire flow may at times be diverted and the return flow be sufficient in amount to supply the lower canals. It has been estimated that the return flow from some of the streams in northeastern Colorado equals one-third of the amount of the diversions. As the return flow from the diversions in the earlier season may reach the stream so as to increase the later season low flow, this is of very material assistance in supplying canals.

That the percolation losses in irrigation are large is also shown by the rate of discharge which may be secured from drainage systems in irrigated lands. The records of some drainage systems show the water removed to equal from 20 to 30 per cent of the amount applied to the land. As further amounts will be removed by the natural ground water drainage, the general figures given for average losses of 10 to 15 per cent in canal laterals and 20 to 30 per cent in deep percolation from fields do not seem unreasonable. For poorly maintained canals or for careless use of water on porous soil the amounts of such losses may exceed and even double the figures given.

FLOW OF WATER IN WOOD STAVE PIPES.

Bulletin 376 of the U. S. Department of Agriculture on "The Flow of Water in Wood Stave Pipe" adds much to our present knowledge of this important subject.

For formulas for the flow of water in wood-stave pipe, the exponential form is recommended. The formulas deducted by Mr. Scobey are:

$$H = \frac{7.68\ V^{1.8}}{d^{1.17}} = \frac{0.419\ V^{1.8}}{D^{1.17}}$$

$$V = 1.62\ D^{0.65}\ H^{0.555}$$

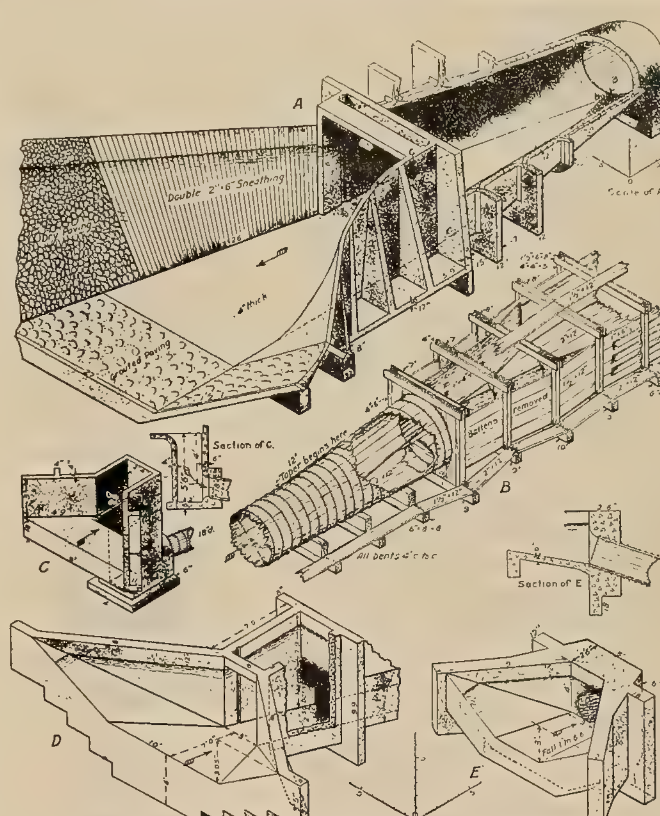
$$A = 1.272\ D^{2.65}\ H^{0.555}$$

in which

H = friction loss in feet per 1000 ft. of pipe.
V = mean velocity of water in feet per second.
d = mean inside diameter in inches.
D = mean inside diameter in feet.
A = mean discharge in second-feet.

Factors of safety of from 5 to 15 per cent are recommended where the conditions of use such as silted water, growths of vegetable life are unfavorable, or where penalties for deficient capacity are attached.

In his discussion Mr. Moritz deduces a formula



Governmental Suggestions for Inlet and Outlet. Structures for Inverted Siphons.

of the form $H = \frac{0.43\ V^{1.8}}{D^{1.25}}$ from the results of these experiments. This gives results 7.6 per cent smaller than the formula previously suggested by Mr. Moritz and now used by many engineers. This difference is due to the fact that Mr. Scobey tested a number of the larger sized pipes which gave lower capacities than the test of the large pipe for which results were available when the early Moritz formula was derived.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

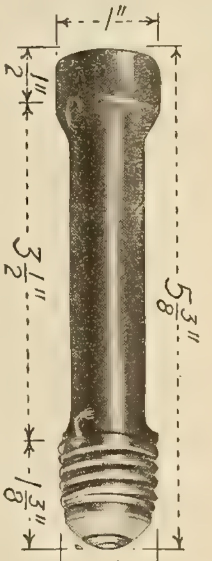
(Resistance units to replace carbon lamps, new methods of specifying pulley dimensions, too much battery and a "safety first" flush receptacle are some of the new problems that are solved for the contractor and dealer in this issue. Other articles on perplexing problems of wiring installations, motor control and operation, window display, cost keeping and a thousand hourly obstacles to business efficiency in the life of the contractor and dealer are soon to follow. The author is apparatus specialist for the Western Electric Company.—The Editor.)

SIZE OF RESISTANCE UNITS TO REPLACE CARBON LAMPS.

Now that carbon lamps are not so generally used and because the characteristics of Mazda lamps do not make them desirable for resistance purposes, resistance units are being widely adopted to replace carbon lamps. The difference between the Mazda lamp and the carbon lamp is that in the former the resistance increases very rapidly with the current, whereas the resistance of the carbon lamp is fairly constant over a wide range of current. Resistance units are, however, so designed that the resistance remains practically constant at any current the units will safely carry.

These resistance units are made up by winding wire of German silver or some similar material upon supporting tubes, which are then covered with a cement-like coating or with a fused vitrous enamel. The tubes consist of asbestos paper, lava, pottery, enameled iron or other miscellaneous material, depending upon the type of unit and its purpose. Many different forms of terminals or attachments can be furnished to make them suitable for mounting in special apparatus or for making up special groups of resistances.

When adopted to replace lamps, the unit equipped with a standard Edison screw base is most convenient. A unit mounted in this manner is shown in the illustration, which also gives the principal dimensions. This particular unit has a capacity of 60 watts for continuous duty or 210 watts for 20-second duty, and can be furnished in any resistance from 2 to 1000 ohms. Many other sizes can be furnished, each of the several manufacturers of resistance units having many different ratings and types.



To replace an 8 candle-power, 110 volt carbon lamp, the manufacturer of the particular unit shown recommends a unit wound for approximately 440 ohms, with a maximum carrying capacity of .37 amperes, or a unit of 220 ohms, and .52 maximum amperes, to replace a 16 candle-power lamp of the same voltage. Two of these 220 ohm units connected in parallel will be equivalent to a 32 candle-power, 110 volt lamp. While the cost of such units is considerably more than carbon lamps, they have the advantage of not being easily broken and will last indefinitely if not worked beyond their safe carrying capacity.

It is well to note that while the term "resistance unit" is used in this article, the more correct expression is now "resistor unit," in accordance with the latest standardization rules of the American Institute of Electrical Engineers. Article 81, under caption "Definitions," in these rules reads: "Resistor. A device, heretofore commonly known as a resistance, used for the operation, protection or control of a circuit or circuits." This recommendation is being adopted by the various manufacturers as their descriptive literature and price sheets are revised, and will shortly be in general use.

TOO MUCH BATTERY.

The four requisites of a reliable annunciator signal system are a good annunciator, a suitable system of conductors thoroughly insulated to prevent grounds, crosses or short circuits, a battery of the proper type and number of cells, and the necessary signal stations, usually consisting of push buttons. When properly installed such apparatus is not likely to get out of order, but it is occasionally necessary to renew the battery. Ordinarily, however, the batteries receive no attention whatever until the system fails to work so it is quite logical to blame run down batteries for almost every case of annunciator trouble.

A case of annunciator trouble quite different from those commonly reported caused by too many batteries was once noted by the writer.

A one hundred drop annunciator had been installed in a hotel. After having been in use for a few months it began to give trouble, only indicating part of the time. The repairman immediately inspected the battery and decided to add three more cells to the original set of three making six No. 2 Samson batteries in series, which should be sufficient for a very large system. After working for a few weeks the same trouble again developed.

But this time another repairman came upon the job. He also decided that more battery was required and added two more cells. The system kept going from bad to worse and finally for some unknown reason the battery was increased to a total of sixteen cells connected eight cells in series and two banks in parallel. This, however, did not remedy the trouble.

About that time the local inspector of the lighting company happened to see the repairman working on the trouble and listened to his story of the mystery. The inspector suggested that the large number of

cells had probably burned the contacts in the bell. This was found to be the case. A new bell was fastened on the back of the annunciator without disturbing the original one and the leads transferred to it. Then all but three cells of battery were removed. The system then worked perfectly, much to the surprise of the several repairmen who had failed to locate the real cause of the trouble.

This same thing is likely to happen when using bell ringing transformers if the voltage of the secondary is too high. In either case the lowest possible voltage should be used. Some of the modern transformers have several taps giving more than one voltage, so the best voltage for the particular circuit can be selected. This permits the bells nearest the transformer to work at one voltage and those farthest away at another, if necessary.

NEW METHOD OF SPECIFYING PULLEY DIMENSIONS.

In the past it has been customary when ordering pulleys for motors and generators to specify the diameter and face of pulley required in addition to the usual information covering shaft dimensions. This method appears to have been somewhat unsatisfactory, as one of the large manufacturers of paper pulleys now recommends that the belt width be adopted in preference to the pulley face. The full width of pulley is then made to exceed the belt width by approximately the following amounts:

Belt width within the following limits.	To obtain full width of pulley belt width is increased by
Up to 2 in.	¼ in.
2 to 5 in., inclusive.	½ in.
5 to 12 in., inclusive.	¾ in.
12 to 24 in., inclusive.	1 in.
24 to 36 in., inclusive.	1½ in.
36 in. and larger.	2 in.

For example, a pulley 4½ inches in diameter with a face width of 4½ inches would have an effective face of 4 inches and be suitable for a four-inch or smaller belt.

This method has been adopted by a number of motor manufacturers, and is recommended to others who are interested in such apparatus.

It is well to note that double belts should not be used on pulleys smaller than 9 inches in diameter, and that the belt speed in any case should not exceed 5000 ft. per minute, because high belt speeds reduce the arc of contact on the pulley by centrifugal action.

The maximum pulley diameters which can be used with motors and generators at various speeds with belt speed limited to 5000 ft. per minute are as follows:

Speed r.p.m.	Max. Safe Pulley Diam. in in.	Speed r.p.m.	Max. Safe Pulley Diam. in in.
1800	11	750	25
1500	13	720	26
1200	16	600	31
1000	19	514	37
900	21	450	42
800	23		

A "SAFETY FIRST" FLUSH RECEPTACLE.

The principal objection to the ordinary screw base receptacle has always been the possibility of shock by accidental contact or the short-circuiting of contacts, and excessive arcing with the danger of short circuits on removing the plug with the circuit closed. These very shortcomings of this form of receptacle undoubtedly explain, at least in many cases, why baseboard receptacles are not more commonly used in residences, for it is a fact that some people are rather dubious about such devices, especially where there are children in the family. And there is really some grounds for this feeling, for every once in a while one hears an incident relating how a child was badly frightened or perhaps slightly burned its fingers by inserting some metal object, quite often a pair of scissors, into one of these receptacles. Even though there is not an actual physical injury, the experience is rarely forgotten and often related to neighbors and friends. Then again there is generally the expense and aggravation due to blown fuses which may cut off the entire service.

Still this form of receptacle is very useful and very common, because it is the only type now on the market which will accommodate all makes and styles of attachment plugs which are ordinarily furnished with miscellaneous appliances.

To overcome the objections herein noted there is now being placed upon the market a line of screw base flush receptacles in which both contacts are normally dead and become alive only upon screwing the plug full way into the receptacle. The center contact has to be pressed solidly inward and the outer or shell contact becomes alive only when drawn outward, both motions being completed when the plug is screwed into place. Upon removing the plug with the current on, the circuit is broken at three points in series, thus greatly reducing the possibility of serious arcing.

This is a truly "Safety First" device and should prove an unusual leader for the electrical contractor, for it eliminates a strong objection often raised against baseboard receptacles. More receptacles mean more appliances, the effect is cumulative.

EMERGENCY REPAIR PARTS.

In these days of slow delivery and depleted stocks every dealer handling motor installations can do those of his customers having such apparatus a good turn by calling to their attention the advisability of carrying a few spare parts for an emergency. A few parts kept on hand represent but a small investment but may ultimately mean a saving equal to many times their cost. Still it is surprising to note how often this matter is entirely neglected

The number of parts which should be carried will depend largely upon the number of motors in use, their type and size and upon whether the motors are to operate under severe conditions where there is more likelihood for breakdowns. For direct-current and single-phase motors it is good practice to carry a set of bearing linings and brushes. For squirrel-cage induction motors a set of bearing linings will usually be all that is necessary except when the motors are equipped with starting compensators in which a set of contact fingers and segments with necessary screws should also be carried for each size. If the motors are of the slip-ring type a set of brushes for the collector rings, a set of fingers or segments for the controller and a set of bearing linings should be provided.

ELECTRIC COOKING AND HEATING

(The electric furnace is finding an ever increasing field of application in the industries of the West. Its economc features and delicate control are so superior to any other known source that it bids well to replace other methods of heat application. In this article the author sets forth the fundamental factors that enter into electric furnace design and illustrations of typical installations are given.—The Editor.)

ELECTRIC FURNACES.

BY E. A. WILCOX.

Economic Advantages.—The use of electric energy for producing furnace heat has revolutionized many modern industries. The field which it has created in the development of electrochemical and metallurgical processes has great possibilities. Not only does the electric furnace afford opportunity for improving and widening these industries, but its use

Pouring From Snyder Steel Furnace.

requires large quantities of electric power, the development of which produces a market for energy that might otherwise lie dormant or go to waste. Furthermore it improves the load factor and diversity of large central station loads, and otherwise tends to foster greater economic wealth.

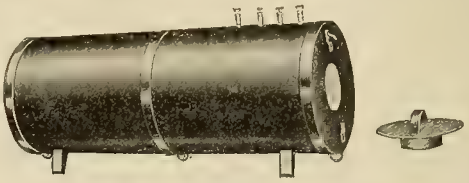
Only high temperature furnaces for melting and refining various substances will be considered in this chapter. The general design, manner of operation, and field of application of electric furnaces will be outlined so as to convey an understanding of the subject.

The Electric Furnace Field.—The application of the electric furnace has made it possible to manufacture a number of substances that would otherwise not be available for commercial purposes if combustion methods were the sole means of production. None other than electric furnace methods have ever been successfully employed in the manufacture of such well known substances as carborundum, aluminum, and calcium carbide. Immense industries have been built up, and great quantities of power employed for their production. There are many other processes that may be performed only with the electric furnace, but the extensive applications of which are limited by the cost of production. There is little doubt but that more of the supply of nitrogen required for soil fertilization will be drawn from the air by electric furnace apparatus, as the present rapidly depleting natural nitrate deposits become exhausted. Several plants located where electric energy is cheaply produced, now manufacture great quantities of nitric acid and nitrates and consume enormous amounts of power.

The electric furnace may create temperatures greatly in excess of those otherwise available. With present apparatus operating temperatures as high as 6500° F. may be attained. The exclusion of objectionable furnace gases and air, makes it possible to perform many new operations. The smelting of various metallic ores that formerly could not be handled satisfactorily or economically has been made possible.

Probably the greatest field for utilizing the electric furnace, at the present time, is in its application to such processes as are now largely performed with fuel burning furnaces. It is in this field, however, that the electric method has to compete on the basis of both cost and quality of product.

Character of Furnace Power Loads.—Some concerns using electric furnaces do not attempt twenty-four hour operation on account of the usual inefficiency of night work. This is especially true of those engaged in steel manufacturing. Some furnaces have to be shut down while the products are removed and new charges introduced. The resulting load factor is relatively high, however, as compared with average central station motor service.



G. E. Laboratory Tube Furnace. (Max. temp. 1832° F., 2½ in. diameter, various lengths.)

Some smaller furnace installations may be shut down from three to four hours per day without serious disadvantage and this condition often makes it possible to utilize off-peak power. Where steel melting furnaces are used, it has been found advisable in many instances to mould during the day and melt at night. This practice has developed an all-night furnace load for the power company.

The variations in current in an electric furnace are usually due to changes in condition of the charge. Some furnaces are operated in series with a ballast. For direct current service the ballast has to be a resistance, whereas for alternating current service a resistance or a reactance may be used. The power

factor of induction furnaces is generally low. It may be raised by lowering the frequency, or by using a synchronous motor as a condenser.

Character of Service Required.—Alternating current is used in furnace work more often than direct current. For induction furnace operation alternating current is employed, whereas direct current is required in electrolytic furnaces. In most arc and resistance furnaces either alternating or direct current may be employed.

The voltage required for furnace work is generally low (50 to 200) although in nitrogen furnaces pressures as high as 5,000 to 10,000 volts are often utilized. The size of furnace loads usually makes it necessary to reduce the voltage at the point of delivery, and consequently almost any available primary

G. E. Crucible Furnace. (Max. temp., 1112° F., crucible 1 in. by 2 in. high.)

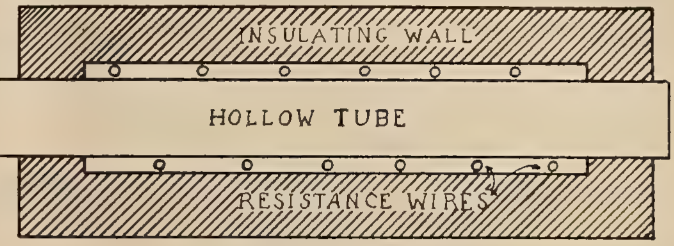
voltage may be used. The higher the voltage applied the less is the current required, the smaller the electrode cross section, and the less the heat conducted out of the furnace through the electrode. Voltages are limited, however, from considerations of the safety of operators.

Arc and resistance furnaces are usually built for 60 cycle operation in sizes under 1000 kilowatts. Larger furnaces are generally constructed for lower frequencies. Induction type furnaces usually require special low frequencies in sizes larger than 500 kilowatts capacity.

Most furnaces are operated with single-phase service. The larger resistance furnaces for manufacturing chemical products, graphite, and carbide use single-phase service. Nitrogen fixation furnaces are generally connected so as to use three-phase current. Two and three-phase energy is frequently utilized in steel making although it is contended by some manufacturers that single-phase service is more efficient and satisfactory from the standpoint of furnace operation. A single electrode furnace is somewhat cheaper and more readily manipulated; the heat losses are less; and the electrode and refractory roof costs are smaller. On the other hand, most power producers prefer to deliver two or three-phase energy for obvious reasons. Central station companies having 4-wire, three-phase distribution systems are sometimes able to supply single-phase service by suitable arrangement of tranformer connections.

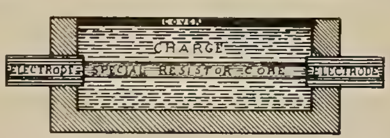
Classification of Electric Furnaces.—Electric furnaces may be divided into two general classes, the resistance type, and the arc type. It is often difficult to distinguish the class to which different furnaces belong, because both the heat of the arc, and the heat resulting from the resistance to the flow of current, are frequently utilized in heating the charge.

Resistance type furnaces may derive heat from the passage of current through resistance wires, through other resistance materials surrounding the charge, or by the passage of current through the



Tube Furnace.

charge itself. Examples of furnaces employing resistance wires as a means for heating the charge are found in the ordinary small crucible, tube, and muffle type furnaces often used in laboratories for operation at temperatures under 1800° F. Typical examples of the second type of resistance furnaces are those of the Acheson carborundum furnace and some of the well known high temperature electric crucible furnaces. The induction type furnace, wherein a current is induced in the charge by electromagnetic induction, is one of the best examples of the third type of resistance furnace. A sharp distinction between these three classes is often impossible because some types involve more than one principle in their design.



Furnace With Resistance in the Charge.

Arc furnaces may be divided into three classes, the principles of which may or may not be combined in one type of apparatus. The first class, known as the direct arc furnace, produces heat by causing an arc between the electrode and the charge. The second class known as the series arc furnace passes current from one electrode to the charge and from the charge back to another electrode. The third class, known as the indirect arc furnace, produces heat between electrodes supported above the charge.

A more complete classification of electric furnaces is given by Stansfield in his excellent text on "The Electric Furnace" as follows:

Classification of Electric Furnaces.

(1) Resistance Furnaces.
- (a) Using special resistance.
  - (1) Resistance wires in furnace walls (tube furnace.)
  - (2) Resistance material in the charge (carborundum furnace.)
- (b) No special resistance.
  - (1) Electrolytic (aluminum furnace.)
  - (2) Using charge as resistance.
    - (a) Solid material (graphite furnace.)
    - (b) Melting material (Heroult smelting furnace.)
    - (c) Liquid material (induction furnace.)

(2) Arc furnaces.
- (a) Direct arc.
  - (1) Single arc (Girod furnace.)
  - (2) Series arc (Heroult furnace.)
- (b) Indirect orc (Stassano furnace.)

FUEL OIL AND STEAM ENGINEERING

(Fuel oil and steam engineering to be properly understood must be considered from the fundamental laws of energy. In this article the author begins with the laws of motion originally propounded by Sir Isaac Newton and ends with setting forth the principle of conservation of energy wherein it is shown that fuel oil practice and steam engineering are principally concerned with transforming the latent chemical energy of oil into potential energy of steam, later to be transformed into energy of motion in the power generating apparatus.—The Editor.)

FUNDAMENTAL LAWS INVOLVED IN FUEL OIL PRACTICE.

BY ROBERT SIBLEY.

Mechanical Energy in Reciprocating Units at Redondo.

IN the awful throes of the French Revolution and the immediate years following, the old saying that "every cloud has its silver lining" proved true in certain lines of scientific advancement, for the metric system of units was conceived and put into practice at that period.

Our modern system of Arabic numerals, now practically universally adopted throughout the civilized world, required over five hundred years of human fumbling and competition with the old Roman method of numerical representation, before a complete replacement was accomplished, so intensely are we all creatures of habit and slaves to tradition.

And so it is that although a period of a century is now passed since the institution of the metric system, modern central station engineering practice is still entangled with Fahrenheit scales, boiler horsepowers, mechanical horsepowers, myriawatts, Beaume scale readings for gravity, inches of mercury vacuum, pounds pressure per sq. in., feet and inches—all units related so unscientifically and empirically as to cause bewilderment in itself.

In the following discussion, however, the author shall endeavor to set forth the various units of expression in such simple language that it is hoped that even the beginner may have little difficulty in understanding their meaning. Let us first get some conception of the need for units of measurement and how such units are fundamentally conceived.

Newton's Laws of Motion.—Fable has it that Sir Isaac Newton, when a boy in England, lying one day under an apple tree and gazing upward, saw an apple fall to the ground. The contemplation of this phenomenon lead Newton to give to the world three fundamental laws upon which modern engineering science is built. Briefly stated these laws are as follows:

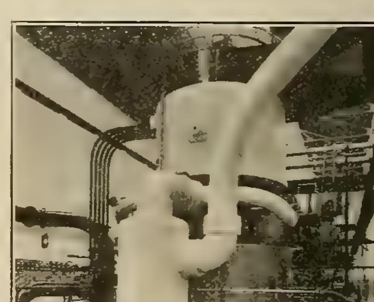
Law 1. Everybody continues in a state of rest or a state of uniform motion in a straight line except in so far as it may be compelled by force to change that state.

Law 2. Change of motion is proportional to impressed force and takes place in the direction of the straight line in which the force acts.

Law 3. To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed.

Hence a force is said to be acting according to Law 1 whenever the physical conditions are such that velocity is changed in magnitude or direction. Thus, when a train of cars is started or stopped, a force is necessary to cause this phenomenon, and this is evidently a change in the magnitude of the velocity. On the other hand, in the rotation of a fly wheel, the velocity may change solely in direction without a change in magnitude, and yet a force be necessary to maintain its parts in equilibrium. Hence a force may be considered as a push or a pull acting upon a definite portion of a body, but this tendency may be counteracted in whole or in part by the action of other forces. In the latter instance the force is usually denoted as pressure, and it is the consideration of this latter case, or the consideration of pressures, that will largely concern our attention in the generation of steam in a boiler.

Three Fundamental Units of Length, Mass and Time.—In considering Law 2, it is seen that there is some inherent property in matter that makes it difficult to set it in motion. Physicists have defined this quality of matter as being the inertia of a body. Inertia is expressed quantitatively in engineering practice in terms of its mass, which is measured in pounds. In order that these quantities, force and mass, now introduced may be quantitatively measured, it is necessary to have some fundamental units upon which to base our computations. Three units only are fundamentally required; namely, a unit of length, a unit of mass, and a unit of time. Scientific practice has deduced for these units the centimeter, the gram, and the second, which are well known and need no further illustration. In engineering practice, however, especially among English-speaking people, the foot, the pound and the second seem to be in almost universal usage. We shall consequently largely express our deductions in terms of these latter units.



Electrical Energy from Steam Turbine in San Francisco.

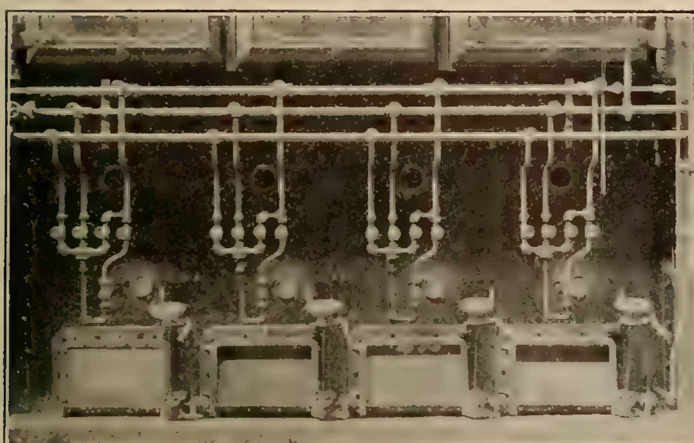
Velocity, Acceleration, and Force Defined.—Having now decided upon the three fundamental units of

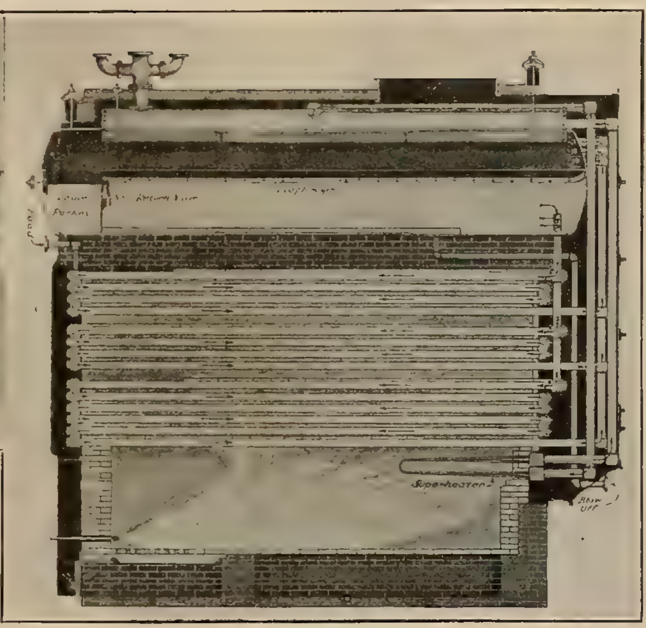
measurement, let us look into other fundamental definitions and secondary units to be employed.

Since engineering science must deal with motion and the change of motion per unit of time, it is necessary that we have units wherein to measure them. Change of motion per unit of time is known as velocity and is expressed in feet per second. A change in motion may, however, be undergoing a change, and this phenomenon is known as acceleration, which is measured by the change of velocity in feet per second.

Since a force, **P** is fundamentally defined as being proportional to the change in motion of a body, it follows that a force is equal to a constant, **M**, multiplied by the change in motion, or, in other words, multiplied by the acceleration, **a**.

When **M** is in pounds mass and **a** is acceleration in ft. per sec. per sec., the force **P** is measured in **poundals**. The **pound force** is the unit, however, that





Chemical Energy in Fuel at Station C in Oakland Showing Method of Fuel Oil Application and Formation of Gases in Furnace.

has been universally adopted in engineering practice. The pound is such a force as will give to a pound mass the same change of motion per second as is acquired by a body falling freely to the earth's surface. A body falls to the earth's surface with an acceleration of g ft. per sec. per sec., wherein g has an average value of about 32.16. We have then the fundamental mathematical expression for force n pounds as follows:

$$P = Ma \qquad (1)$$

Whenever, however, it is necessary to ascertain the mass **M** in pounds from the known weight **W** of the body in lb., it is necessary of course to divide **W** by **g** in order to ascertain the mass. Thus we have in

$$\text{this case } P = \frac{W}{g}a \qquad (1a)$$

Thus, if an automobile weighing 3000 lb. accelerates from a stand-still to forty miles per hour in fifteen seconds, we compute the force required to accomplish this as follows:

$$P = \frac{3000}{32.16} \times \frac{40 \times 5280}{60 \times 60 \times 15} = 367 \text{ lb.}$$

Since this total force must be supplied from the engine cylinder this now gives us a preliminary clew as to how the total engine cylinder area is to be proportioned.

Bodies acquire different changes of motion per second, or, in other words, different accelerations at different points on the earth's surface. A formula has been established by means of which proper corrections may be made. A concrete illustration of this will appear in the next chapter wherein a mercury column is used to measure atmospheric and vacuum pressures at different latitudes and altitudes.

It is unfortunate that mass and force have the same unit of expression, for they are definite distinct physical concepts and should be carefully distinguished in order to avoid confusion.

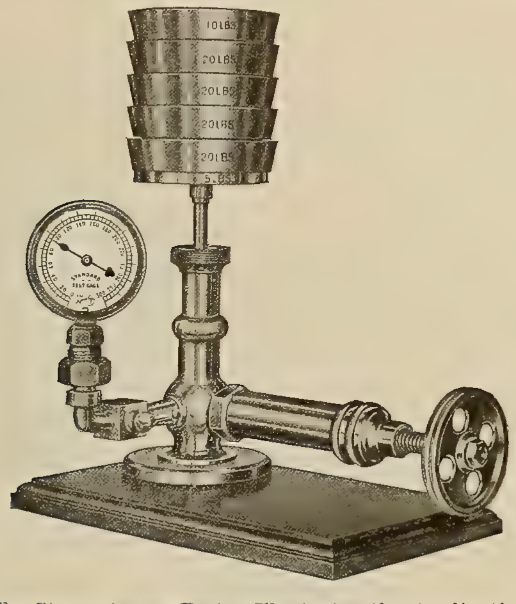
Conception of Work and Power.—In Law 2 we are informed that the change of motion takes place in the direction of the straight line in which the force acts. It is often convenient to note quantitatively the product of the force and the distance through which the force acts. This product is called "work" and is numerically computed by multiplying the force in pounds by the distance in feet through which the force acts. The resulting computations are then expressed in foot-pounds (ft. lb.). Thus, if the mean effective pressure, **P**, in a cylinder is measured in pounds per sq. in. and the piston has an area of **A** sq. in., it follows that the total force or pressure acting in the direction of the motion of the piston is **PA**. When this force has pushed the piston the length of its stroke, **L** ft., the work accomplished is **PLA** ft. lb., since this is the product of the force and the distance through which the force acts. If there are **N** working strokes per minute, the ft. lb. of work accomplished every minute are now seen to be **PLAN**.

The mention of the words "per minute" in the last statement now indicates to us that the time taken to perform a given quantity of work in engineering practice is of vast importance. Consequently this fact necessitates still another unit of measurement, namely that of power. Power is defined as the time rate

of doing work. The horsepower is the basic unit. When 550 ft. lb. of work are performed per sec., or 33,000 ft. lb. per minute, a horsepower is said to be developed. Hence, since in the above engine cylinder **PLAN** ft. lb. per min. are being developed, the horsepower is computed as follows:

$$\text{H.P.} = \frac{\text{PLAN}}{33{,}000} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Thus, in Alameda, California, a certain Diesel oil engine has a piston area of 37.7 sq. in., a stroke of 1.5



The Steam Gauge Tester Illustrates the Application of a Fundamental Law, wherein a Pressure is Balanced Against the Force Due to Gravity.

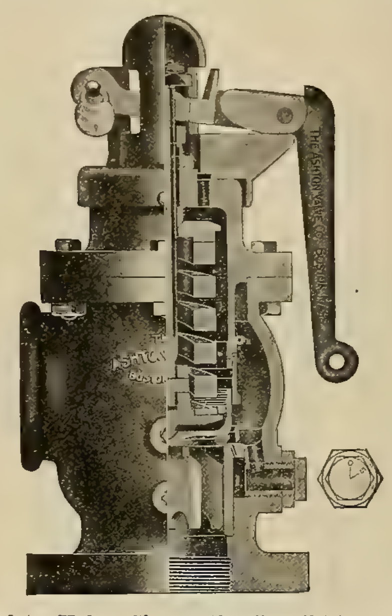
ft., a mean effective pressure of 23.36 lb. per sq. in., and each cylinder makes 125 working strokes per minute. Hence, each cylinder develops

$$\text{H.P.} = \frac{23.36 \times 1.5 \times 37.7 \times 125}{33{,}000} = 50.0$$

In a later discussion the particular power units employed in steam engineering practice will be considered in minute detail, such, for instance, as the horsepower, the boiler horsepower, and the myriawatt.

Various Types of Energy Employed for Useful Work.—Another important consideration is that of the physical characteristic of a body which enables it to perform work. This physical quality possessed by a body which enables it to perform a definite quantity of work is spoken of as its energy. Energy then is the capacity for work. In general we meet with two great classes of energy. One is that of **kinetic energy,** or energy of motion. According to Law 2, if the motion of a body be changed, a force is required. Hence a body actually in motion possesses kinetic energy. The other type of energy is known as **potential,** or energy of position. Thus steam moving with a high velocity, by the nature of its kinetic energy, is enabled to drive the wheels of an impulse turbine. On the other hand, crude petroleum when heated so that it will unite with the oxygen of the air gives out energy in the form of heat, which may be caused to do useful work. The energy inherently latent in the crude petroleum is known then as potential energy. Engineering practice is largely concerned with the harnessing of various forms of energy. Looking about us in nature and in modern engineering accomplishment, we may see numerous instances of energy. The steam engine and steam turbine indicate a form of mechanical energy; the incandescent light, or the dynamo, that of electrical energy; the evolving of heat in the burning of crude oil, that of chemical energy; the human conducting of affairs, that of human energy; the rays of light from the sun, dissipating eternally 10,000 h.p. over each acre of the earth's surface, that of solar energy, and so on indefinitely. Modern investigation has conclusively established the fact that all types of energy are interchangeable, and though some types of energy are more readily convertible into other types, yet the basic law is true that no energy in sum total is ever destroyed, and on this basis, or law, known as conservation of energy, practically all of our engineering formulas and computations are evolved.

The conversion of the chemical energy of crude oil into heat energy of the furnace and thence into steam largely concerns our attention in this discussion. Thus each pound of California crude oil will be found in later articles to contain approximately 18,500 British thermal units of heat energy. This energy of one pound of oil when wholly converted into mechanical energy is sufficient to lift a person weighing 150 pounds through a vertical skyward journey of some 18 miles. Hence the study of the application of such enormous reservoirs of energy, latent in crude petroleum, will prove intensely interesting and instructive.



The Safety Valve Shows the Possibility of Safety Application, when Pressures Become Unbalanced.

Bearing in mind these fundamental laws, we should now be able to see mentally the exact changes of energy that are going on in the modern power plant. First as chemical energy in oil, next as latent heat energy in chimney gases, then as latent heat energy in steam, next as energy of motion in the moving parts of the power generating apparatus, the final transformation as electrical energy is brought about.

SPARKS—Current Facts, Figures and Fancy

A half-million dollar plant in Wyoming designed for the manufacture of gasoline and carbon black from the flow of gas in the oil wells of that commonwealth is now under construction.

* * *

With but one single exception the quicksilver output of California during the past year which was valued at nearly four million dollars is the largest in the history of that state.

* * *

The new year finds the West in better financial position than ever before in her history. Bank deposits and bank clearings never before reached such totals as are now being recorded.

* * *

A well known Eastern authority has recently been quoted as saying that the thing that justifies the advertising of electricity is that everybody has a desire to use it, or at least to be a beneficiary of its service.

* * *

The electrical exports for October last have again set a new record. A total export value of over four million dollars in value representing nearly twelve and one-half per cent increase over the best previous month is recorded.

* * *

Constructive imagination combined with an inward appreciation of the symmetry and beauty of harmonious development is becoming more and more to be recognized as one of the greatest assets that the engineer may possess.

* * *

Manchuria, the rich province of northern China, will harvest nearly two million tons of beans this year. The well-known power possibilities of this section of China will some day be a rich natural asset to aid in its economic agricultural development.

* * *

The steam from a volcano in central Tuscany, Italy, is utilized in power development. It is said that a three thousand kilowatt steam plant is so operated. Perhaps the great volcano in the Hawaiian Islands may some day find similar application.

* * *

As an instance of the growing American commercial and engineering relations the dividend of the Nippon Yusen Kaisha steamship line plying between Japan and Seattle may be cited. A dividend of twenty-eight per cent per annum has just been issued.

* * *

The output of coal in the United States for 1916 was considerably over a half billion tons and broke all previous records. Crude petroleum output also passed all previous records in a total production of 292,300,000, twenty-five per cent of which came from California oil fields.

* * *

Copper has soared in value to such profitable heights that the right to recover metal from river slime by scraping the great deposits along river bottoms in the Coeur d'Alene country of Idaho is being asked of the farmers owning the riparian rights who are to receive a five per cent royalty.

* * *

An electrical man of Oregon has built his home so electrically equipped that no chimney has been included in the design. The Diesel engine has made possible the ocean-going vessel without the customary smoke-stack and now electricity bids well to complete the transformation in the home.

* * *

The steamship Balboa has lowered the record for time of passage through the canal. Entering from the Pacific at 11:35 a. m., Sunday, December 3, she reached Cristobal at 6 p. m., having taken 6 hours and 25 minutes in passage. On the same day the Cauca made the transit in 7 hours and 9 minutes, and the San Juan in 8 hours and 5 minutes.

* * *

Ship building continues unabated on the Pacific Coast. The launching of the seventy-one hundred ton turbine ship Thordis, at Oakland, during the week to be followed shortly by another of similar capacity, together with one of ten thousand ton capacity is typical of weekly progress throughout the other ship building districts of the West.

* * *

Texas and Kansas farmers are making sweeping returns on broom corn. One man realized one hundred and seventy-five dollars per ton for his crop. The house broom is used West of the Rockies and the electrically operated pump is supplying the water to its productive lands. Perhaps this is enough said as a tip to Western power salesmen for new business.

* * *

The U. S. Geological Survey in its recent report to the Secretary of the Interior, commenting on the efficiency of Western mining operations, calls forceful attention to the fact that again copper stands out as the best illustration of how American mines can meet a world demand. The output of nearly 2 billion pounds of the red metal is double that of ten years ago and its value is twice that of the copper produced in 1915. Add to this the fact that in value copper now contends with iron for first place among the metals and that together the amount of these two metals produced last year had a value of more than one billion dollars and we have a measure of what this country can contribute in useful metals.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

THANKS.

The Journal takes this opportunity of expressing its heartfelt appreciation to the scores of its readers that have either verbally or by letter so cordially and enthusiastically intimated their approval to the enlarged activities that were undertaken by the Journal with its last issue.

The Pacific Coast Section of N.E L.A.

The past week has witnessed a notable event in the life of the electrical industry of the West. The Pacific Coast Section of the National Electric Light Association, formed at Los Angeles by officials of a majority of the electric light and power companies in the states of California, Arizona, Nevada and New Mexico, bids well to prove a factor of highest usefulness in bringing out an even greater economy and unified action in the electrical industry of the West.

A total capital investment of two hundred millions of dollars is involved in the membership of the new organization. With R. H. Ballard of the Southern California Edison Company heading the list of active workers in the new organization backed by a host of other well-known, influential men of the industry, it would seem that the organization should meet with enthusiastic support from its very incipiency.

The new section should not only strengthen the spirit of co-operation among the members of the national organization in this section of the country, but the harmonious evolution of Western central station problems that is bound to result should immeasurably instill into the national organization itself many new and life-giving enthusiasms.

Here in the West have arisen many engineering problems that are peculiarly our own. Men of the West have risen to manfully cope with them, and their persevering attitude has won an unusual measure of success. This new section should aid vastly in still further meeting Western needs and in advancing the electrical industry to still further usefulness in serving the need of our citizens. The Journal extends to the New Pacific Coast section of the National Electric Light Association its heartiest "bon voyage."

Electricity and Turbine in Coast Shipbuilding

Editorial reference was made in the columns of the Journal in our issue of November 25, 1916, to the splendid outlook in Pacific Coast ship building. The months that have passed since that time have begun to bear fruit in actual launching and testing of new ships that surpasses all previous expectations.

The launching of the Thordis, a seventy-one hundren ton turbine ship in the Oakland yards on January 6 and the later launching of another ship of similar tonnage, together with still another of ten thousand tons displacement on January 20th from the same ship building district, are typical of this splendid new activity all up and down the Pacific Coast.

The thing, however, that is especially pleasing to men of the electrical industry is the ever-widening sphere of activity that electricity and the steam turbine are playing.

In the former editorial attention was called to the possibility of local central loads that are to result when these ships put into port and desire to load or unload with motors receiving their driving energy from local power companies.

It is interesting also to note in passing to what gigantic widening applications the steam turbine has been put in recent months. Not only has this source of power generation practically driven its former competitor, the reciprocating engine, from the field in the modern central station, but now in combination with a reduction gear attachment it is proving itself master of the sea.

Monopoly Under Regulation

The happenings in Los Angeles during the past two weeks are of immense interest to engineers of the West.

Ever since public regulation of utility companies has been in vogue there has been constantly growing in the minds of all thoughtful investigators along these lines the conclusion that competition and regulation are two issues that are diametrically opposed the one to the other.

The main reason for this is that competition of necessity involves duplication of service and this latter feature means increased cost of production. On the other hand public regulation of a utility makes possible all the economic features of low cost of production and yet holds the earnings within reasonable bounds.

Hence the controversy in Los Angeles between the proposed advent of municipal power and the private power companies already occupying the field has been watched by all on-lookers with unusual attention.

In the final adjustment of this controversy and its various resultant ramifications it would seem that what started out to be a disastrous and bitter competitive fight is now to result in vast economic advantage for all parties to the issue.

In the first place the city of Los Angeles agrees to take over the entire distribution systems of the private company, paying therefor a price fixed by the Railroad Commission after a careful investigation of the costs involved. This will enable the power companies to dispose of their city holdings in a manner just and reasonable to the owners and at the same time provision is made whereby the city may purchase additional power from these companies as occasion may demand at a price that will net the privately-owned companies eight per cent on the investment incident to the delivery of this power.

The second rather remarkable result of the controversy is the gigantic merger that has been brought about between the Pacific Light & Power Corporation and the Southern California Edison Company. Here again is a factor that will be of immense economic importance to the future hydroelectric industry of Southern California and to the consumer.

Under public regulation it will seem that complete monopoly of the industry would be of economic advantage to both utility company and to the public at large.

This growth toward centralization of utility investment is not a local one. According to the Chief of the Forest Service, in his annual report, the merging of hydroelectric companies is going on uniformly throughout the entire West.

Since monopoly is thus advocated, it would seem common justice, if the laws of Western commonwealths are not sufficient to bring under their jurisdiction the proper regulation of publicly owned power plants upon the same basis of review that the privately owned plants must pass that enactments should be brought about to make this possible.

Under such complete supervision wherein the publicly owned and privately owned plants are regulated by the same disinterested utility commission the ideal is reached and monopoly thus becomes in truth the economic factor in utility development.

New Stave Pipe Formulas

The constant use of large quantities of wood stave pipe in the construction of hydroelectric installations in the West has necessitated the frequent use of formulas for computing the flow for a pipe of definite design. Such formulas have in the past been inaccurate and often misleading.

In Bulletin 376 of the U. S. Department of Agriculture on "The Flow of Water in Wood-Stave Pipe," a commendable innovation has been made by the government in its method of presenting experimental data and the conclusions drawn from it. This bulletin contains the results of a large number of new and carefully made experiments on the carrying capacity of wood-stave pipe as well as the data on available tests from other sources. These results were used as the basis for the development of a formula for the capacity of such pipe which differs somewhat from those previously recommended by other investigators. Before publishing these results, proofs of the bulletin were sent to a number of engineers who have been prominent in the testing of such pipe and the development of formula for its carrying capacity. Their criticisms were solicited and a number of their suggestions adopted. The bulletin as finally published contains the data and conclusions of Mr. F. C. Scobey, who conducted the experiments for the government and also the comments of Mr. Gardner S. Williams, T. A. Noble, D. C. Henny, E. A. Moritz, E. W. Schoder and L. M. Hoskins. The treatment is similar to that of papers presented before the larger engineering societies, Mr. Scobey replying to such comments in the closing discussion. A portion of the comments are critical in nature and serve to call attention to the controversies still existent among engineers as to the best form of formula for the carrying capacity of pipes. To those not closely in touch with the recent developments of such formulas, the discussions serve to give a much better perspective of the status of the subject than could be secured from a bulletin containing only the views of a single author. The engineers who supplied such discussions gratuitously are entitled to the thanks of the profession and the government is to be commended for adopting this method of treatment of a subject of this character.

PERSONALS

Geo. T. Tiffany, an electrical contractor at Stockton, has recently retired from the electrical field.

G. S. Campbell of the Truckee River General Electric Company was a recent visitor at Los Angeles.

Frank Hanish, an electrical and plumbing contractor of Roseville, Cal., was a recent visitor at San Francisco.

R. W. Turnbull, with the Portland office of the General Electric Company, is spending a few days at San Francisco.

John Stanovich of the Central Electric Company, Watsonville, California, spent New Year's day and eve in San Francisco.

W. E. Hayes, manager of the Hayes, Van Fleet Electric Company of Santa Rosa, spent a few days in San Francisco last week.

H. S. Batchelder of the Western States Gas & Electric Company of Stockton was a recent business visitor at San Francisco.

W. L. Brittle of the Western Gas & Electric Appliance Company, of Chico, was a recent business visitor at San Francisco.

W. W. Briggs of the Great Western Power Company, of San Francisco, recently returned from a few days' trip to Los Angeles.

Chauncy Carr, heating specialist of the General Electric Company of Los Angeles, was a recent business visitor at San Francisco.

T. C. Browne of the Federal Sign System (Electric) of Salt Lake City, spent a few days the latter part of the week at San Francisco.

John A. Britton, vice-president and general manager Pacific Gas & Electric Company of San Francisco was a recent visitor at Los Angeles.

W. J. Grambs, assistant to the president of the Puget Sound Traction, Light & Power Company, has returned to Seattle from a trip to California.

F. Schuyler of the Los Angeles office of the Allis-Chalmers Company, has recently been transferred to the San Francisco office where he will resume his duties.

Henry Karge of the Nevada Telephone Supply & Construction Company, Carson City, Nevada, has returned after spending two weeks' holiday vacation at San Francisco.

Chas. Davis, manager of the Boston district of the General Electric Company, recently arrived at San Francisco after an extended trip through the Orient and will continue his trip East shortly.

F. J. Verfurth, general manager of the Central California Electric Company of Lindsay, recently returned from an extended trip throughout the East, where he visited the various factories which he represents.

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, is making an extended trip through Arizona in the interests of the Pacific Coast Section of the National Electric Light Association, the Society for Electrical Development and the Journal of Electricity.

L. Y. Woodmansee, formerly superintendent of generation for the Arizona Power Company at Prescott, Arizona, has been appointed electrical engineer for Electrical District No. 2, in Arizona, which irrigation district receives its supply of electrical energy from the Roosevelt Dam of the Salt River Project.

H. R. Noack, formerly president of the Pierson, Roeding Company of San Francisco, and one of the best known electrical men on the Pacific Coast, has recently accepted a position on the sales staff of the Pacific States Electric Company, with headquarters at San Francisco. Mr. Noack will have charge of the high tension transmission and pole line business of that company.

F. H. Leggett, formerly Pacific Coast manager of the Western Electric Company, was the guest of honor at a luncheon given at Tait's restaurant in San Francisco on the 29th of December. Those present who participated in this farewell party were W. S. Berry, E. J. Wallis, H. B. Squires, H. E. Sanderson, Garnett Young, S. B. Gregory, R. F. Oakes, R. M. Alvord, Carl Heise, E. M. Cutting, Walter Wurfel, R. J. Davis, J. A. Vandegrift, Walter Seaver, S. W. Gilman, Miles F. Steel.

Romaine W. Myers, a consulting engineer on electrical and illuminating problems, with headquarters in Oakland, California, has been appointed California representative of the Illuminating Engineering Society, with membership on the committees of membership and sustaining membership of that organization. Mr. Myers has also been appointed by the advertising bureau of the Oakland Chamber of Commerce to have charge of all electrical and illuminating effects at the Ad Masque Ball to be given in Oakland's new Civic Auditorium on February 14, 1917.

W. L. Goodwin, formerly Pacific Coast manager Pacific States Electric Company, who has accepted a position with the General Electric Company in Schenectady, N. Y., was the guest of honor at a farewell party on January 5th. There gathered together on the Claremont Country Club course as guests of T. E. Bibbins, all of the golfers of the electrical fraternity of San Francisco. Some good golf was played and some bad golf, but altogether a good time was enjoyed by all. In the evening all were gathered around the table for dinner, where good fellowship was shown, and regrets were expressed at Mr. Goodwin's proposed departure. During dinner Mr. C. C. Hillis, in his jovial way, expressed the sentiments of all, in presenting in the name of the Socket Club a gold watch beautifully engraved with the names of the members of the club. Those in attendance at golf and dinner were Messrs. Geo. C. Holberton, H. V. Carter, W. L. Goodwin, S. B. Anderson, H. E. Sanderson, R. J. Davis, S. B. Gregory, Roscoe Oakes, C. E. Wiggin, W. S. Berry, W. A. Blair, Garnett Young, Miles Steele, Walter Seaver, E. O. Shreve, C. C. Hillis, O. W. Lillard, F. C. Phelps, T. E. Bibbins, H. B. Squires, S. H. Taylor, D. E. Harris, Stanley Walton, R. M. Alvord.

ORGANIZATION OF PACIFIC COAST SECTION NATIONAL ELECTRIC LIGHT ASSOCIATION.

The Pacific Coast Section of the National Electric Light Association was organized at a meeting of representative electrical men held in Los Angeles on January 6th. Aside from organizing and determining to hold a convention in April, the most important business transacted was the appropriation of $500 for carrying on the investigation of insulator troubles and the request that Class D members (manufacturers, jobbers and electricians) be put on a parity with Class A members as regards voting and holding office.

The officers of the newly organized section are as follows:

President—R. H. Ballard of Los Angeles.
Vice-Presidents—H. F. Jackson of San Francisco and Samuel Kahn of Stockton, Cal.
Secretary—A. H. Halloran of San Francisco.
Treasurer—A. N. Kemp of Los Angeles.

Executive Committee.

Henry Bostwick, Pacific Gas & Electric Co., San Francisco.
W. W. Briggs, Great Western Power Co., San Francisco.
Wm. Baurhyte, Los Angeles Gas & Elec. Corp., Los Angeles.
Geo. S. Campbell, Truckee River Gen. Elec. Co., Reno, Nev.
E. R. Davis, Pacific Light & Power Corp., Los Angeles.
W. P. Southard, Albuquerque Gas, Elec. Lt. & Power Co., Albuquerque, N. M.
F. S. Viele, Prescott Gas & Electric Co., Prescott, Arizona.
A. Emory Wishon San Joaquin Light & Power Corp., Los Angeles.
A. B. West, Southern Sierras Power Co., Riverside, Cal.

President Ballard announced the appointment of a public policy committee, as follows:

John A. Britton, chairman; W. A. Brackenridge, H. H. Jones, S. M. Kennedy, A. G. Wishon.

The personnel of the engineering, commercial, accounting and membership committees will be announced later.

MEETING NOTICES.

Los Angeles Jovian Electric League.

An interesting program was given at the luncheon on January 3d. President A. E. Morphy introduced T. J. Royer, of the R. A. Rowan Company, as chairman of the day, who was followed by David A. Curry, known as the "Stentor of Yosemite." In an entertaining address on "Our National Parks" he stated that thirty-three thousand visitors journeyed to Yellowstone and predicted that this number would reach one hundred thousand for 1918.

John Topham, city councilman, also addressed the league, taking for his subject "The Trouble Shooter." The trials and tribulations of a councilman were explained in a heart to heart talk and the city's side of the power situation was also discussed.

Pleasing and entertaining vocal and instrumental numbers were rendered by Miss Spaulding.

San Francisco Electrical Development and Jovian League.

The January 3rd meeting, the first after the Christmas recess, was devoted largely to a discussion of the recent increase in the national Jovian dues. Inasmuch as the local league has been paying the national dues of its Jovian members, a corresponding increase in local dues becomes necessary. Such an increase was proposed in tentative amendments to the constitution, which were submitted for general discussion. A division of opinion at once resulted. One side, as ably represented by W. S. Berry, advocated a complete severance of national relations. T. E. Collins argued in favor of federalization. H. V. Carter suggested that the organization be conducted purely as a Jovian League. As a simple solution to the complex schedule submitted, A. H. Halloran suggested that the local dues remain as heretofore and that an extra $2.00 be collected from Jovian members next October, the league secretary also collecting the dues of all Jovians in the territory. It was indicated that a possibility existed of returning to the old basis after the meeting of the next Jovian congress. The executive committee has taken matter under advisement, and will report at a later meeting. R. M. Alvord, presiding officer, then requested E. M. Cutting to express the league's regret at F. H. Leggett's departure for New York City. Mr. Leggett responded by telling of the great pleasure and benefit he had derived from association with the league members, and shook hands with all members after the meeting adjourned.

ELECTRICAL ENGINEERS MEET IN PITTSBURGH TO DISCUSS IMPORTANT QUESTION.

The American Institute of Electrical Engineers held its last meeting in Pittsburgh on January 12, 1917, with headquarters at the Fort Pitt Hotel.

Following the policy adopted a short time ago, the Institute, instead of confining its session to one annual meeting during the year, has decided to hold several meetings at stated intervals in various parts of the country.

The Pittsburgh meeting was devoted to a discussion of "Braking Electric Vehicles by Regeneration," using the energy generated on down grades to apply brakes to the vehicles.

The paper on this subject was presented by Mr. R. E. Hellmund of the Westinghouse Electric & Mfg. Company. The meeting will be presided over by Mr. Harold W. Buck, of New York City, president of the Institute.

NOTES ON UTILITIES COMMISSION OF IDAHO.

In the matter of the filing of annual reports under Section 27 of the Public Utilities Act, the commission has ordered, that all public utilities operating within the state of Idaho which are subject to the provisions of the Public Utilities Act be required hereafter to file in the office of the commission on or before the thirtieth day of September in each year, reports covering the period of twelve months ending with the thirty-first day of December preceding said date, giving the particulars called for in the annual reports required by the commission; provided, that as to all public utilities which are not required to file annual reports with the Interstate Commerce Commission in conformity with the order of the Interstate Commerce Commission made and entered as of the twenty-fourth day of November, 1916, the report to be made for the year ending December 31, 1916, shall cover only the period from July 1, 1916, to December 31, 1916, inclusive.

In the matter of the publication and filing by each common carrier engaged in interstate commerce and operating in the state of Idaho, of a complete index of tariffs in effect and to which it is a party either as an initial or delivering carrier, the commission has ordered that each common carrier operating in the state of Idaho, who, under the regulations of the Interstate Commerce Commission as set out in Tariff Circular No. 18-A, is required to publish and file an index of tariffs in accordance with Rule 11 in said tariff circular, shall enter after each I. C. C. number in its list of the numbers of tariffs of its own I. C. C. series arranged in numerical order, its corresponding P. U. C. I. number, and shall in the same publication wherein appears the list wherein are entered said P. U. C. I. numbers as aforesaid, publish a list of the numbers of intrastate tariffs and circulars of its own P. U. C. I. numbers, and enter after each of said P. U. C. I. numbers the corresponding carrier number; provided, that the publication of the indices hereinbefore required may be made in a state supplement if the carrier so desires.

In the matter of the application of the Project Mutual Telephone & Electric Company, a corporation, for a certificate of convenience and necessity to construct and operate a telephone line within the village of Rupert and over what is known as the north side of the Minidoka Reclamation Project, in which the Mountain States Telephone & Telegraph Company, a corporation, appears as intervenor, the commission has ordered that the petition be denied.

UTILITY COMPANY NOTES.

Western States Buys Large Water Rights and Irrigating System.

Western States Gas & Electric Company, a subsidiary of the Standard Gas & Electric Company, with headquarters at Stockton, Cal., has arranged for the purchase of large water rights which will make its present water power on the American River at Placerville, Cal., a 100 per cent effective power all the year. The purchase includes the site, water and flowage rights for a 50,000 h.p. hydroelectric development. Authority for the purchase is being sought from the California Railroad Commission. The expenditure involves an outlay of approximately $190,000 and covers four large lakes, a number of minor ones, and an irrigating system in Eldorado and Amador counties. There is already an established income from the irrigating business sufficient to more than pay interest charges on the purchase price. It will more be unnecessary for the Western States Company (Stockton Division) to purchase water during drought seasons as in the past. The purchase places the company in a stronger position than ever before and gives it assurance of being able to supply all power demands for years to come.

The company's output and business are growing satisfactorily in all divisions. Gas output of the Stockton division

on December 7, 1916, amounted to 1,101,000 cu. ft., the largest in the history of the company. The output for the week ended December 7 showed an increase of 19.29 per cent over the corresponding week of last year. Part of this increase is ascribed to the large gains being made in gas heating load in response to the company's efforts along these lines. Commercially, Stockton, in common with other cities of the country, is enjoying a healthy growth. Bank clearings for the week ended December 14 amounted to $1,884,150, a gain of 55.3 per cent over the corresponding week of 1915, which places Stockton fifth in the United States in percentage of gain compared with last year.

The Richmond division of the company has secured a contract with the Standard Dredging Company for 600 h.p. in motors, covering the latter's power requirements while dredging the new Inner Harbor, which work will require about five months to complete.

Western States Gas & Electric Earnings.

Report of the Western States Gas & Electric Company for the month of November shows continued increase in both gross and net, the net increase for the month of November over November, 1915, being 14.1 per cent as compared with an increase of 4.2 per cent in the net for the year. Comparative figures follow:

Month of November:	1916.	1915.	Inc.	% Inc.
Gross earnings........	$112,442	$106,197	$ 6,244	5.9
Net earnings	56,954	49,928	7,025	14.1
Year ended Nov. 30:				
Gross earnings........	1,232,887	1,183,834	49,053	4.1
Net earnings	593,958	569,941	24,016	4.2

Reorganization of Northern Idaho and Montana Power Company.

Elmer Dover, president of the Northern Idaho & Montana Power Company, has been named receiver for the corporation by Judge Rudkin of the United States District Court at Spokane. It is stated that this action is preparatory to a friendly reorganization whereby the capitalization will be reduced and the company equipped with funds for the construction of immediate and future extensions. For several years the Northern Idaho & Montana Power Company has not earned its full bond interest charges, due to the failure of the communities served in Oregon, Washington, Montana and Idaho to develop in population and industries as rapidly as was expected when the original investments were made in the physical properties. The managers of the property, H. M. Byllesby & Company, have made every effort to place the company on a profitable basis without success. With the return of prosperity to the lumber industry and the resumption of agricultural development a considerable quantity of profitable new business may be obtained by making extensions which the company is unable to finance in its present condition. In order to best conserve the interests of security holders and to properly serve its field reorganization is deemed necessary by the management.

The Northern Idaho & Montana Power Company and its subsidiary, The Oregon Power Company, operate in territories with about 50,000 population, centering at Kalispell, Montana, Sandpoint, Idaho, Newport, Washington, and Albany, Eugene and Marshfield, Oregon.

ELECTRICAL IRRIGATION DISTRICT NO. 2.

A section of the Salt River Valley in Arizona lying just east of the Salt River Valley Irrigation Project, and embracing nearly 70,000 acres, underlaid with what is evidently a living lake of water at depths varying from 70 ft. to 90 ft. at different parts of the district, has recently been organized into an "Electrical District," according to the provisions of a law passed at the last session of the Arizona legislature. This district (centering around Higley, Arizona), will be known as "Electrical District No. 2," and proposes to secure power from the Roosevelt system and electrify the whole district and reclaim by pumping plants the vast acreage of fertile land it embraces. A board of seven trustees will govern the affairs of the district and they expect to be in shape in a very short time to offer bonds for sale to secure the funds for executing the work and contracts for a complete transmission, transforming and control system. L. Y. Woodmansee has been selected as secretary and engineer of the district.

TRADE NOTES.

A. J. Myers, Pacific Coast manager of the Wagner Electric Manufacturing Company, announces the change in address of that company from the Rialto Building to 159 New Montgomery street, San Francisco.

W. L. Mitick announces the change in the name of the Pacific Electric Motor Company, (Conradt Electric & Motor Company) to the Pacific Electric Motor Company, now located at 564 Eighteenth street, Oakland.

T. J. Bennett, announces the change of the name of the Rex Electric Company, formerly at Polk & Sutter streets, San Francisco, to the Rex Electric & Engineering Company, (contracting and repairing) now located at 253 Minna street.

The Federal Electric Company of 618 Mission street, San Francisco, announces its formation for the marketing of all electrical goods, except electric signs, formerly manufactured and sold by Federal Sign System (Electric) in the Pacific Coast territory. The Federal Electric Company is closely allied to Federal Sign System (Electric), which latter company will continue its activities as before concentrating on electric signs, permitting the Federal Electric Company to handle the remainder of its lines. Mr. E. A. Bullis of San Francisco is sales manager of the Federal Electric Company. Mr. T. W. Simpson, as vice-president and Western district manager of Federal Sign System (Electric) will generally supervise the activities of the newly formed Federal Electric Company.

NEW BULLETINS.

The Wagner Electric Manufacturing Company of St. Louis has just issued a fifteen page illustrated pamphlet describing a modern lumber mill with its electrical and mechanical equipment.

A new 8 page pamphlet has just been published, including descriptions and illustrations of C-H Push Sockets manufactured by The Cutler-Hammer Manufacturing Company of Milwaukee. This folder is of the type furnished to dealers and jobbers carrying imprint for distribution.

Catalog No. 8, a new 48-page booklet describing and listing C-H Push Button Specialties is now being distributed by The Cutler-Hammer Manufacturing Company of Milwaukee. This revised catalog contains 138 illustrations of sockets, switches, plugs, receptacles and other wiring devices as well as 14 diagrams of the wiring connections for the C-H automobile lighting switches. The information on C-H Push Sockets now include several new types that have been added since the previous catalog was published.

C-H electric dryers for beer vats, C-H electric industrial stoves, C-H circulation type water heaters, C-H electric plate warmers, C-H immersion type water heaters and C-H electric glue pots are described in six small envelope enclosures just issued by the Cutler-Hammer Manufacturing Company of Milwaukee. Uniformly distributed and accurately controlled heat, which is not affected by drafts of air and a heater without dirt, soot or ashes, and which does not vitiate the air or overheat the room, the some of the advantages of the electric devices over the gas and oil appliances which they replace.

LATEST IN EVERYTHING ELECTRICAL

(New ideas in electrical design and method of handling business affairs of the industry are constantly arising. In this issue our readers will find new ideas for individual control for candle fixtures, a new electric soldering iron, a new heater unit, and the latest product in the electrical supply year book. Watch for the new ideas that will be presented in our next issue.—The Editor.)

NEW BRYANT SOCKETS PROVIDING INDIVIDUAL CONTROL FOR CANDLE FIXTURES.

Various efforts have been made from time to time to provide individual control for candle fixtures without destroying the symmetry of appearance or the rigidity of construction of the fixture.

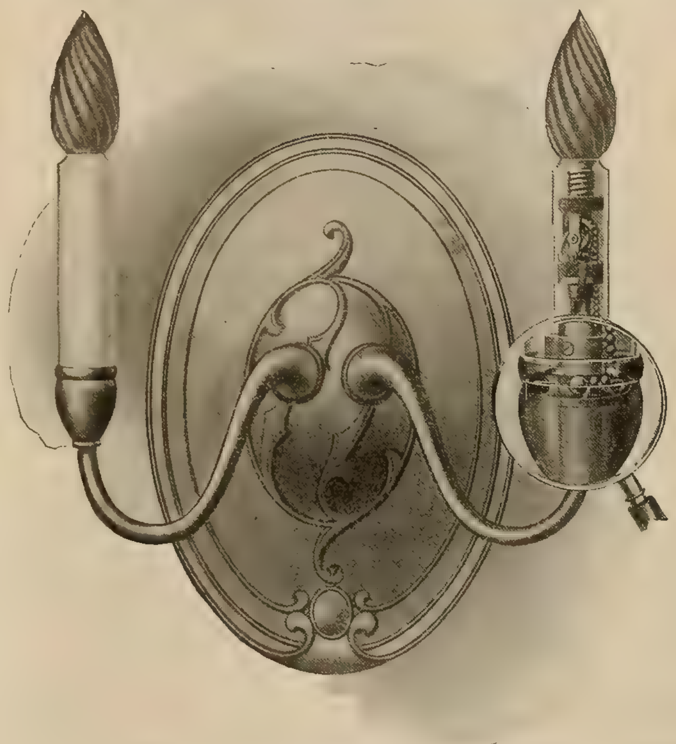
In the Bryant medium and candelabra base, candle "pull" and "turn" sockets, however, as will be noted from the detail views, these two ideas have been fulfilled. In both devices the substantially designed operating mechanism is rigidly fastened near the top of the candle. By this arrangement advantage is taken of space within the candle which has heretofore been wasted, and ready access is provided to the binding screws for wiring. Because the mechanism and parts are not crowded together, the danger of short circuit is practically entirely eliminated. Furthermore, the arrangement of the mechanism lends itself to practically any design of fixture, as the bobeche may be made as small as might be desired, while the cup may be liberally proportioned without interfering in any way with the perfectly satisfactory operation of the switch. As will be noted from the illustrations, the chains from the pull sockets, catalog numbers 540 and 4120, hang perpendicularly in the candles and are carried through very small holes in the bobeche and candle cups, leaving only enough chain extending from the bottom of the fixtures to permit of easy location and operation of same.

Bryant Candelabra Pull Socket. (No. 540).

Medium-Base Candle Pull Socket (No. 4120.)

In the "turn" devices, catalog numbers 560 and 4121, two circular superimposed discs are provided. These two discs, in addition to the sockets, numbers 540 and 4120, can be inserted in any fixture by firmly fastening the upper one to the pipe stem with the lower disc securely fastened in the bobeche or candle cup. The rotation of the latter, in either direction, will pull the chain down sufficiently to operate the socket. In this way the entire operating mechanism is completely hidden from view and the very daintiest candle fixtures can be made up with individual control lights. It will be noted that the bead chains are provided with a splicing link close to fixture proper, which permits fixture manufacturer to disconnect the lower exposed portion of chain for special finishing to match balance of fixture.

In the medium base device, the mechanism is firmly supported within a liberally designed molded insulation block of non-breakable material instead of the old style porcelain block, while the candelabra base is supported by three heavy brass "legs" which absolutely prevent any side-play, even when the pull chain is actuated by a sudden jerk. The switch mechanism consists of a thick insulated disc with pall spring and ratchet contact and escapement. Another feature worthy of note to the fixture manufacturer is that these sockets fit inside standard porcelain and fibre candles.



Candelabra Turn Socket (No. 560) with Enlarged View showing Detail.

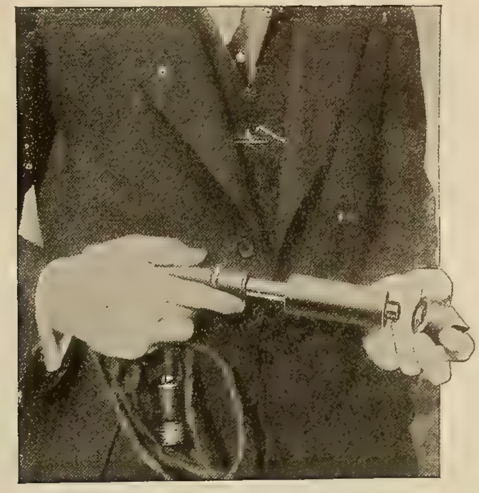
FINAL DECREE IN GENERAL ELECTRIC COMPANY TUNGSTEN LAMP CASE.

Final decree was entered November 15, 1916, in the suit of the General Electric Company against the Laco-Philips Company of New York for infringement of the Just and Hanamann tungsten filament lamp patents. Payment was made to the General Electric Company of approximately $95,000 on account of damages for infringement of this patent.

The bill of complaint in the case was filed by the General Electric Company in 1912. The suit was argued in the District Court, Southern District, of New York, November, 1915. Judge Mayer decided in favor of the General Electric Company in February, 1916. The case was appealed by the defendant and argued in the United States Circuit Court of Appeals in New York last May. This court affirmed Judge Mayer's opinion in June and final decree was entered November 15, 1916.

NEW C-H ELECTRIC SOLDERING IRON.

The electric heating unit of a new type of electric soldering iron is hermetically sealed inside the body of the iron. This prevents moisture, heated solder or flux from penetrating a joint and coming in contact with the heater wire. The



The Electric Soldering Iron.

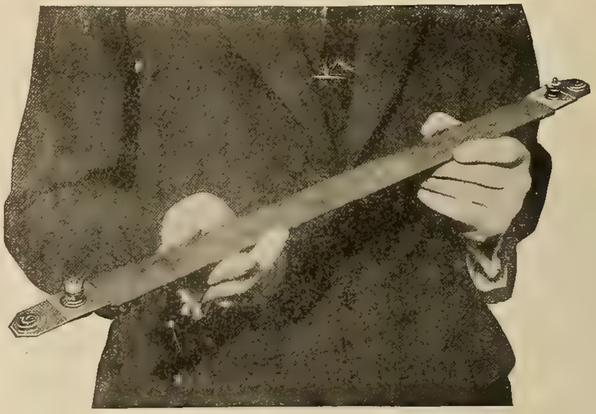
same metal,—steel, is used throughout the structure of the body to eliminate the liability of opening of seams due to unequal expansion. The copper tip does not screw into a hole in the iron body but the C-H design is such that a threaded core extends from the body and over this the tip is screwed. The heated core of the body therefore passes directly into the copper tip leading the heat in and concentrating it where it is required.

Five standard sizes are made by The Cutler-Hammer Mfg. Company of Milwaukee. The sizes vary in diameter from ⅝ in. to 1¾ in. Besides being used for all soldering purposes they may be used for melting wax, for branding, etc. The advantages of cleanliness, efficiency and convenience of electric soldering irons are well known and further comment is unnecessary.

ELECTRIC HEATING OF CRANE CABS WITH C-H TYPE "H" HEATER UNITS.

After the first of November the cabs of outdoor cranes usually become uncomfortable for the operator because of the cold. Various methods of heating these cabs are in use, but nothing entirely successful from all standpoints has been developed. Space is at a premium and for this reason grid resistance banks, because of their dimensions, are usually unsuitable. The Cutler-Hammer Manufacturing Company, of Milwaukee, has been adapting its Type H enclosed steel-jacketed heater unit for many industrial heating applications, including the heating of crane cabs. Such men as crane operators, and shearmen and tablemen in steel plants can keep their bodies properly clothed and warm, but the feet will get cold in most cases. By supporting a heavy, perforated metal plate about two inches from the floor and placing these flat H units in the air space between the plate and the floor, a warm air current will circulate up through the perforations. Additional units may be distributed at other points for raising the temperature to a comfortable degree, a minimum of space being required. The units have a capacity of 500 watts, and can be used on either direct or alternating systems. They are 1½ in. wide, 3/16 in. deep and 2 ft. long, just like a flat ruler. They require no assembly of parts and can be installed singly or in groups connected in multiple, like so many lamps. All parts being enclosed, they are not easily damaged by mechanical abuse or vibrations. The steel jacket entirely encloses the nickel chromium resistor, which is in turn enclosed in mica.

Insulated eyelet terminals are provided for mounting. Standard units are made for 115, 230 and 250 volt circuits.



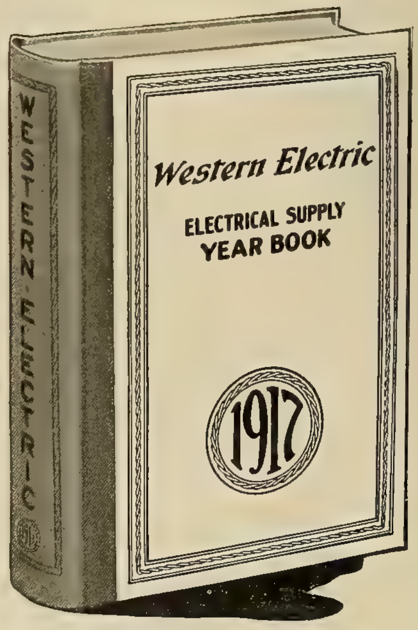
Steel-Jacketed Electric Heater Unit.

They eliminate the fire hazard and the resistor being doubly insulated, there is no chance of grounds. In mounting only sufficient clear space need be provided to permit free movement of air.

NEW ELECTRICAL SUPPLY BOOK.

Much study has been given to the proper manner of presenting to the trade a complete list of electrical supplies and equipment carried by the large houses. The last word in efficient presentation of such matter has this year been brought out by the Western Electric Company.

In January, 1915, the Western Electric Company brought out its first issue of the Year Book, which superseded its general catalog, and in 1916 the second issue came out. The method of bringing out a Year Book and thus giving up-to-



New Electrical Supply Book.

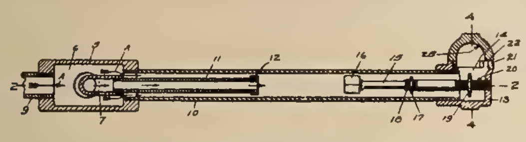
the-minute information has grown to be quite popular with the purchasers of electrical supplies and equipment. The uniform list with one basic discount is also another popular feature. The 1917 Year Book is now ready for distribution to the trade.

WHAT WESTERN INVENTORS ARE DOING

(It is interesting to note in passing that the typical Western inventions listed below, patents for which have been just granted, set forth ideas of fuel oil economy, electric heating and control that are largely occupying the thought of the electrical fraternity as a whole at the present time.—The Editor.)

1,209,566. **Oil Burner.** Edward William Discher, Seattle, Washington.

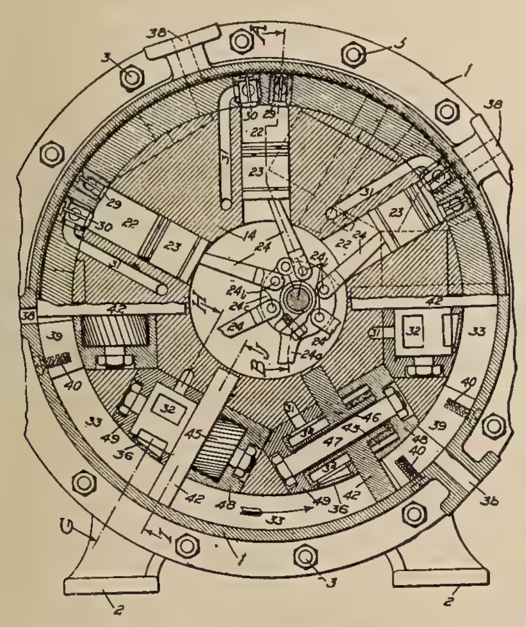
An oil burner comprising a burner pipe provided with vapor and oil inlet means, a nozzle on the end of said pipe, said nozzle having a cylindrical chamber and a horizontally dis-



posed fuel discharge slot, a rod secured to said nozzle and adapted to project rearwardly into said burner pipe in axial alinement therewith, washers of smaller diameter than said burner pipe adjustably secured on said rod within said burner pipe and a washer of substantially the same diameter as said burner pipe adjustably secured on said rod within said nozzle.

1,209,067. **Rotary Internal Combustion Engine.** William M. Sublette, San Jose, California.

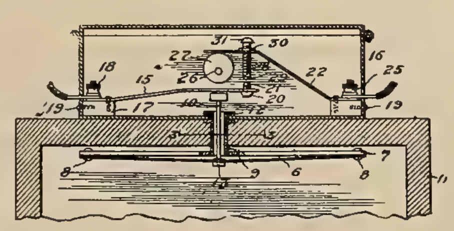
A rotary internal combustion engine, comprising a metal body outer casing cast in two pieces, having metal supports which are an integral part thereof, means by which said two pieces are fastened together, main projections, which are an integral part of said outer casing, adapted to retain bearings



therein, a flange and means of fastening said flange to one of said main projections, a crank shaft having a plurality of cranks forming said crank shaft, one end of said crank shaft being square, said flange being adapted to engage the square end of said crank shaft and hold the same rigid, means for connecting a carbureter to the end of said crank shaft, means by which the mixture of air and gas is admitted through said crank shaft, substantially as shown and described.

1,209,234. **Thermostatic Controller for Electrically Heated Devices.** Clarence Truitt, Pomona, California.

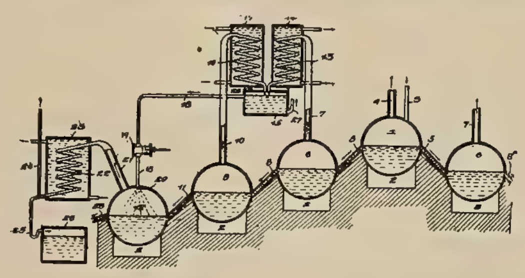
A thermostatic controller for electrically heated devices, a thermostat, a plurality of resilient contact carriers, each of said carriers being provided with an adjustable and removable contact element, one of said contact elements being oppositely positioned to another of said elements, and rotata-



ble means interposed between said carriers to limit the movement and vary the position of one of said carriers.

1,208,214. **Apparatus for Converting the Heavy Products Obtained From Petroleum.** Pedro Roth and Maximo Eduardo Venturino, Buenos Aires, Argentina.

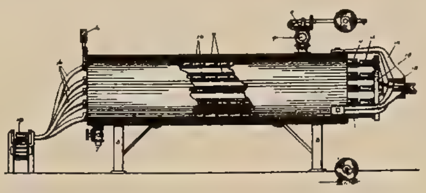
Apparatus for the industrial conversion of the heavy products of petroleum into lighter products, comprising in combination:—a series of boilers arranged in battery, means of connection between every two successive boilers, means



for the discharge of the vapors and gases of distillation from each boiler, means for condensing said vapors and gases, means for separating the condensed heavy or middle hydrocarbons from the water and impurities which they may contain, and means for introducing said liquid heavy or middle hydrocarbons into the vapor space of the lowermost or converting boiler and means for condensing the vapors generated within said converting boiler.

1,209,619. **Automatic Continuous Cooker for Food Products in Hermetically Sealed Containers.** Edward S. Rea, San Francisco, and William S. Rea, Jr., Oakland, California.

A steam cooker for food products in hermetically sealed containers, a cylinder adapted to sustain internal pressure and provided with a suitable steam intake, a series of open tubes within said cylinder and adapted to serve as conduits for said containers during their passage through said cylinder,



in combination with a time-regulated, automatic ram for advancing said containers through said tubes.

NEW ELECTRICAL DEVELOPMENTS

(The merging of the two great power companies of Southern California, the calling of a special election in Los Angeles to vote upon a twelve million dollar bond issue to perfect a municipal electric distribution district, and the continued rumor of gigantic railway electrification in the Northwest constitute the big news items of the week along electrical development lines. The formation of the new Pacific Coast section of the National Electric Light Association and the continued advance of municipal rivalry in effective lighting design and installation also are interesting items of progress. In the following lines our readers will find in detail the new electrical developments of the West since our last date of publication.—The Editor.)

INCORPORATIONS.

PHOENIX, ARIZ.—The Hydro-Power and Irrigation Company has been incorporated by F. Putzell and R. L. Osborn.

SANTA BARBARA, CAL.—Articles of incorporation have been filed for the Santa Barbara Telephone Company by O. C. Spencer, C. A. Hart, J. L. Storia, G. B. Bush and F. L. Rabe.

PORTLAND, ORE.—Publication of the brief announcement from Salem that articles of incorporation of the Santa Barbara Telephone Company of Portland, capitalized at $700,000, had been filed with the State Commissioner of Corporations, revived speculation on the probabilities of the Bell and the independent telephone systems merging in Oregon.

FINANCIAL.

CASA GRANDE, ARIZ.—City bonds for the municipal water and electric light plant have been signed and will go to Powell-Gerard Company, the buyers. It is expected the funds will be sent immediately upon receipt of bonds.

LOS ANGELES, CAL.—The Pacific Electric Railway Company invites bids for the purchase of sufficient 5 per cent bonds covered by mortgage to the Union Trust Company of San Francisco, dated March 12, 1902, to relinquish moneys now in the sinking fund amounting to $15,000.

SPOKANE, WASH.—The Northern Idaho and Montana Power Company, a $5,000,000 corporation, operating public utilities in 35 cities and towns in Montana, Idaho, Washington and Oregon, was placed in the hands of a receiver by U. S. District Judge Frank H. Rudkin. Elmer Dover of Tacoma, was appointed receiver and B. H. Grosscup of Tacoma, counsel for the receiver. The action was the result of an agreement between the company and the creditors.

ANDERSON, CAL.—According to a report of the newly appointed engineer, Thos. R. Means, to a meeting of the directors and land holders' committee of the Anderson Cottonwood Irrigation Project, it will cost $488,000 addition, to complete the system as originally proposed. The estimate of the state engineer's office, upon which the first bond issue was based, was $480,000. This amount has now been practically exhausted and the project is not yet completed. The estimate of $488,000 is in addition to the $480,000 raised by the bond issue.

SAN FRANCISCO, CAL.—According to an announcement made recently by the San Francisco-Oakland Terminal Railways, the company was unable to pay coupons of the S. F.-O. & S. J. Cons. on due dates, and will likewise be unable to pay those falling due during January. In the interests of the bondholders the company has made arrangements with several banks to purchase those coupons as their owners desire for the face value less income tax. The banks joining in this advance consist of the Anglo & London Paris National Bank, the German Savings and Loan Society, Mercantile National Bank of San Francisco, Savings Union Bank & Trust Company, Central National Bank, Oakland; the Oakland Bank of Savings and the First National Bank, Oakland.

SAN FRANCISCO, CAL.—The report of the Northwestern Electric for November and five months shows a gain of about 10 per cent for the month in net income and a gain of about 18 per cent for the period. Earnings after preferred dividend are about 2 per cent on the common stock or about 10 per cent on the market price of the stock. The statement follows:

	1916.	1915.
Gross	$76,458	$67,084
Expenses	32,701	26,443
Net	26,983	24,364
Interest	16,774	16,277
Income	26,983	24,364
Preferred dividend	8,720	......
Surplus	18,263	......
Five months ended November 30—		
Gross	$298,854	$263,470
Expenses	136,310	117,[illegible]23
Net	161,544	146,348
Interest	82,073	80,631
Income	77,472	65,717

ILLUMINATION.

CHICO, CAL.—Bids have been called for installing an electrolier system of street lighting in this city.

PORTLAND, ORE.—The M. J. Walsh Company submitted the lowest bid for furnishing lighting fixtures for the Public Auditorium.

WATTS, CAL.—The board of trustees has ordered the installation of ornamental electroliers on Rosella avenue, from Shorb avenue to Main street.

BAKERSFIELD, CAL.—The council has approved the petition presented by a committee from the chamber of commerce for the installation of 240 electroliers in the business district.

RIVERSIDE, CAL.—In response to an application from residents on Rivera street, the electric line will be extended from the fair grounds across private property to reach homes on Rivera street.

SAN LEANDRO, CAL.—The board of trustees has adopted resolutions to construct a lighting system on E Fourteenth street from the center line of Thornton street across East Fourteenth street.

VENTURA, CAL.—Recommendations made in the annual report of the board of trustees of the California School for Girls calls for an electrolier lighting system for the grounds, and other improvements.

WATTS, CAL.—An ordinance ordering work to be done on Albert street from Electric boulevard to Palm avenue, consisting of the installation of ornamental electroliers, has been passed by the board of trustees.

MANILA, P. I.—A modern electric plant under the management of an industrial association appearing as "The Tacloban Electric Light & Power Plant," will soon be established in the capital of Leyte Province.

SANTA BARBARA, CAL.—Concrete standards have been adopted for the ornamental lighting system on Lower State street, between De la Guerra street and the boulevard by a majority vote of the city council.

RICHMOND, CAL.—Probabilities of electroliers on Macdonald avenue and other business streets are made possible

in a new three-year agreement which the Western States Gas & Electric Company has presented for adoption.

AUBURN, WASH.—S. Cavanaugh, owner of the Auburn gas plant, has transferred his property to a company now being incorporated under the name of the Valley Gas Company, of which Eugene Kuhn of Portland is president.

HEMET, CAL.—Business men of both Hemet and San Jacinto are urging that San Jacinto street be lighted all the way between the two cities, and it is probable that 15 or 20 incandescent lights would be ample for the purpose.

PORTLAND, ORE.—Early in February detailed plans and specifications containing an estimate of the cost of construction and maintenance of a municipal lighting plant will be brought to the attention of the council for consideration.

OLYMPIA, WASH.—The Olympia Light & Power Company has announced that a 1000 h.p. steam auxiliary power plant would be erected in the near future. The plant is to cost $40,000, and the company is planning to sell stock to that amount.

SOUTH PASADENA, CAL.—At a meeting of the city council bids were received for the ornamental lighting system on Mission street, from Fair Oaks avenue to Meridian avenue. The California-Arizona Construction Company's bid of $4895 was accepted.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has awarded the contract to the Southern California Edison Company to install the electric lighting system for the elevated railway at the rear of the Main street station. Consideration, $1410.

LOS ANGELES, CAL.—At a meeting of the board of supervisors a request of the lighting committees of the Palm lighting district for furnishing lamps, glass balls, etc., for an ornamental lighting system was referred to the chief mechanical engineer for recommendation.

FLORENCE, ARIZ.—R. G. Arthur, general manager of the Douglas Investment Company, of which the Florence Improvement Company is subsidiary, states that the company has practically decided to go no further with a franchise for water and electric light systems in Florence.

CORONADO, CAL.—The proposal to install ornamental light posts on Glorietta boulevard, with underground wiring, was discussed at a meeting of the city trustees. Estimates were submitted by the city engineer for the work, as follows: 18 posts, $540; 9000 ft. wiring, $3150; total, $3690.

SAN BERNARDINO, CAL.—That San Bernardino and other valley cities can secure natural gas is the decision of a special committee. It is hoped to obtain the gas from the Fullerton fields. Large pipe lines have already been extended to within a few miles of Pomona and it is expected that city will be furnished with natural gas within a short time.

SANTA BARBARA, CAL.—There is now a reasonable certainty that the installation of ornamental lights on State street shall proceed. Plans and specifications with map and resolution of intention have been adopted by the city council. This provides for extending of metal standards on State to Sala, and concrete from De la Guerra to the boulevard.

LOS ANGELES, CAL.—It has been announced that research work in making the survey of the underground duct facilities of roadway necessary in connection with the new plans for installing an ornamental lighting system for roadway, has been completed. The lighting standard to be used will be about 25 ft. high and will carry two ornamental arc lamps, equipped with the latest developments in glassware.

LOS ANGELES, CAL.—February 2nd has been decided upon as the date for the $12,000,000 power bond election. A formal resolution calling the election will be adopted later and also the proposed contract between the city and the Southern California Edison Company and the Pacific Light & Power Corporation. The power election on the issuance of $12,000,000 bonds for a municipal power system must be held February 2, independently of the county flood control bond election. This was the unanimous declaration of the city council when a consolidation of the two elections was proposed.

TRANSMISSION.

ELSINORE, CAL.—The Southern Sierras Power Company has extended its lines in Cottonwood canyon and, it is reported, will also extend them from Alberhill to Corona.

AUSTIN, NEV.—Elmer Berg has gone to San Francisco where he will purchase all the material necessary for the electric light plant that his firm will install in this town before the coming spring.

NEWPORT, WASH.—The northern Idaho & Montana Power Company, Ltd., has filed a petition with the county commissioners of Pend Oreille county, Washington, asking for a franchise to erect a line for the transmission of electricity.

CASHMERE, WASH.—The committee on the contract for the power with the Wenatchee Valley Gas & Electric Company has under consideration the contract, also the proposition of installing an electric generating plant. They will report in the near future.

KENDRICK, IDAHO.—The county commissioners have granted a franchise to the Potlatch Consolidated Electric Company, giving the company the right to construct and maintain an electric line for the transmission of power on the highways of the county.

SALEM, ORE.—The real estate and water power of the Salem Flouring Mills Company, known as the south mill site, has been purchased by A. N. Bush. Mr. Bush states that he purchased the power site in order to utilize the power for an industry which he will inaugurate in this city.

LOS ANGELES, CAL.—Formal approval of the Public Service Commission has been given to the contract with the American Insulated Wire & Cable Company, whereby that concern is to furnish for use of the municipal power transmission line $165,000 worth of insulated cable.

RICHMOND, CAL.—It is rumored that as soon as the weather will permit in the spring the Great Western Power Company will begin the construction of a high tension power line from an intersection with its 110,000 volt line through Moraga valley out through Morago and down San Pablo Creek to Richmond to connect with a line built westward from Crockett.

MESA, ARIZ.—At a meeting of the city council it was decided to put up to the voters the question of the purchase of the entire plant of the Southside Gas & Electric Light Company. The proposition to be submitted is that the city pay $113,000 for the plant and extensions, the company to pay the cost of the election. The company will hold a meeting in a few days to pass upon the offer of the council.

TELEPHONE AND TELEGRAPH.

CLOVIS, N. M.—It is understood that several of the nearby Texas towns have opened negotiations for telephone lines connecting them with the Clovis territory.

OKANOGAN, WASH.—C. A. Blatt of Nelson, Wash., has applied to the board of commissioners of Okanogan county for a franchise to construct telephone lines upon the county roads.

SPOKANE, WASH.—Improvements aggregating $13,180 have been authorized in the telephone service in Spokane and the Inland Empire, according to an announcement of C. E. Hickman, division commercial superintendent.

DUNCAN, ARIZ.—J. E. Allen and E. M. Luckie, owners of the Duncan telephone system, have arranged for the installation of a telephone line between here and Steeplerock. Work of installation will be commenced at an early date.

CASA GRANDE, ARIZ.—The common council has passed an ordinance granting to the Mountain States Telephone & Telegraph Company a franchise for the erection, operation and maintenance of wires, cables, etc., for a telephone system.

QUINCY, CAL.—J. E. Sutherland, manager of the Pacific Telephone & Telegraph Company in this district, states that M. E. Elcott has started surveying for the new lines to be installed between Quincy and Reno and Quincy and Beckwith.

RIVERSIDE, CAL.—Active work on the consolidation of the Home telephone system of this city with the Pacific system has begun. The switchboard of the Pacific plant will be enlarged and the Home exchange will also be somewhat altered.

SAN FRANCISCO, CAL.—H. C. Chase, for several years district superintendent for the Western Union Telegraph Company, has gone to Topeka, where he will fill the position of general superintendent of the telegraph department of the Santa Fe system.

SILVER CITY, N. M.—The electrical engineer for the government has been at Ft. Bayard inspecting the telephone and telegraph system there. Extensive changes are to be made in the service. The engineer has gone to Fort Bliss to inspect the service there.

LOS ANGELES, CAL.—The city council has notified the Postal Telegraph Cable Company that it would have to file a new petition for a franchise to erect poles and wires in the streets of the city, which will give the city the right to use the poles for municipal wires.

SANTA BARBARA, CAL.—April 1 is the tentative date for the completion of the consolidation of the city and county's two telephone systems into a single system under the name of the Santa Barbara Telephone Company. Plans for construction work have been delayed due to difficulty of obtaining materials and mechanical equipment.

TRANSPORTATION.

SAN DIEGO, CAL.—An amended franchise has been granted to the La Jolla Railroad by the city council, allowing it to use gasoline-propelled cars in the city proper and in La Jolla. The charter granted in 1914 allowed the company to use electricity and the amended instrument permits the use of either or both.

SACRAMENTO, CAL.—An ordinance granting the Northern Electric Company a single track franchise along Thirty-first street was presented to the city commission by Commissioner of Street M. J. Burke. The company, under the former franchise had the right to a single or double track franchise, and when the ordinance is adopted by the commission the franchise at once becomes a single track privilege.

SEATTLE, WASH.—The Great Northern Railway Company is contemplating the expenditure of several million dollars next year in improvement work in the state. Plans are now definitely under way in the St. Paul office for the proposed 120,000 h.p. power plant at Lake Chelan which will generate the energy for electrifying the Cascade division to cost $5,000,000. A joint depot by the Great Northern and Northern Pacific will be built at Spokane to cost $300,000. Plans for terminals at Leavenworth have been completed. Double tracking will be laid between Cutbank and Shelby, Java and Essex, and Columbia Falls and Whitefish, 34 miles.

IRRIGATION.

TURLOCK, CAL. — Gasoline engines will be displaced shortly by electric power as a medium for pumping water for irrigation purposes here.

LOS ANGELES, CAL.—Bids will be received by the United States Reclamation Service for furnishing nine pairs of cast iron skew bevel gears for gate stands for the Rio Grande project, New Mexico.

SAN LUIS OBISPO, CAL.—Land owners of the Tracy irrigation district have declared themselves in favor of the $295,000 bond issue and carried the proposition by a vote of 3 to 1. Construction work will start at once.

WILLOWS, CAL.—The Sacramento Valley Colony Company, whose lands are in the north end of the county, is planning big developments. L. D. Cutler, manager, says 70 pumping plants, electrically driven, will be installed on the lands to furnish irrigation.

CATHLAMET, WASH.—At a recent meeting of the county commissioners a petition praying for the formation of a diking district was presented by the owners of the large tract of tidelands between this place and Skamokawa. This project consists of 3500 acres of valuable land.

GRASS VALLEY, CAL.—Rufus Rockwell Wilson is here in the interest of the thousand-acre tract of land which he controls in the Banner section. It is understood that Mr. Wilson is contemplating placing irrigation water upon the land. The tract will eventually be improved and subdivided.

CHICO, CAL.—The engineering plans of G. I. E. Goodner for the Paradise irrigation district have been approved by State Engineer McClure, according to word received by directors of the district. No alterations were made in the plans. A bond election for the district will probably be called soon.

RIALTO, CAL.—At a meeting of the board of trustees the matter of the extension of the water system to close-in ranches was taken up. After lengthy discussion a committee was appointed to confer with the water company regarding the extensions, which probably will lead to some consideration of the purchase of the water system by the city.

EL CENTRO, CAL.—The application of the Imperial Irrigation District to the First National Bank at Los Angeles for a loan of $200,000 has been accepted by that institution. The loan will extend for a period of six months and is expected to carry the district through until such time as bonds will provide funds. The notes will bear 6 per cent interest.

DOYLE, CAL.—An effort will be made to obtain legislation in California and Nevada which will permit of the organization of irrigation districts which comprise land in both states. The matter is brought up by the organization of the Southern Lassen district. Elbert Howard, president; William Steffins and Herbert Smart, directors of the district, and S. T. Jeffreys, connected with the federal reclamation work in Nevada, are making efforts in this direction.

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WILLOWS, CAL.—In the Glenn-Cadora-Princeton district, which carried by a vote of 130 to 35, there are 18,000 acres, which will be watered from two pumping stations. One of these stations is to be located at Sidds Landing, the other, one mile north of Princeton. These stations will be along the River Branch Canal, which will be purchased by the district. The entire cost, including installation of pumping plants, will be about $144,000. Twenty-five miles of the Central Canal have been completed at a cost of approximately $1,000,000. Twenty-three miles still are to be completed from Stony Creek to a point about four miles north of Willows. The expenditure for the work yet to be done, it is said, will not exceed $300,000.

Devoted to the Generation, Distribution and Utilization of Energy

JOURNAL OF ELECTRICITY

VOL. XXXVIII NO. 3   SAN FRANCISCO, FEBRUARY 1, 1917   PER COPY, 25 CENTS

Rainbow Falls, at Head of Lake Chelan, Washington, in Which District Is Located Sufficient Energy to Electrify a Transcontinental Railroad.

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JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII | SAN FRANCISCO, FEBRUARY 1, 1917 | NUMBER 3

General View of Folsom Dam and Headgates, Upper Canal

A NEW RECORD FOR LOW HEAD DEVELOPMENT

BY RUDOLPH W. VAN NORDEN, Mem. A. S. C. E.; Fel. A. I. E. E.

(Here is a description of an unusual harnessing of waterpower, constituting as it does a new record for low head hydroelectric development. Historically speaking the original Folsom installation from this same canal source was the pioneer in power transmission. The new plant recently designed and installed by the author of this article under authority of the State Department of Engineering, is intensely interesting in that turbines are so designed as to efficiently handle hydraulic heads of but eight feet. The installation was built by the labor of the convicts at the state institution, which proved efficient and free from accident.—The Editor.)

One of the Operators on the Job.

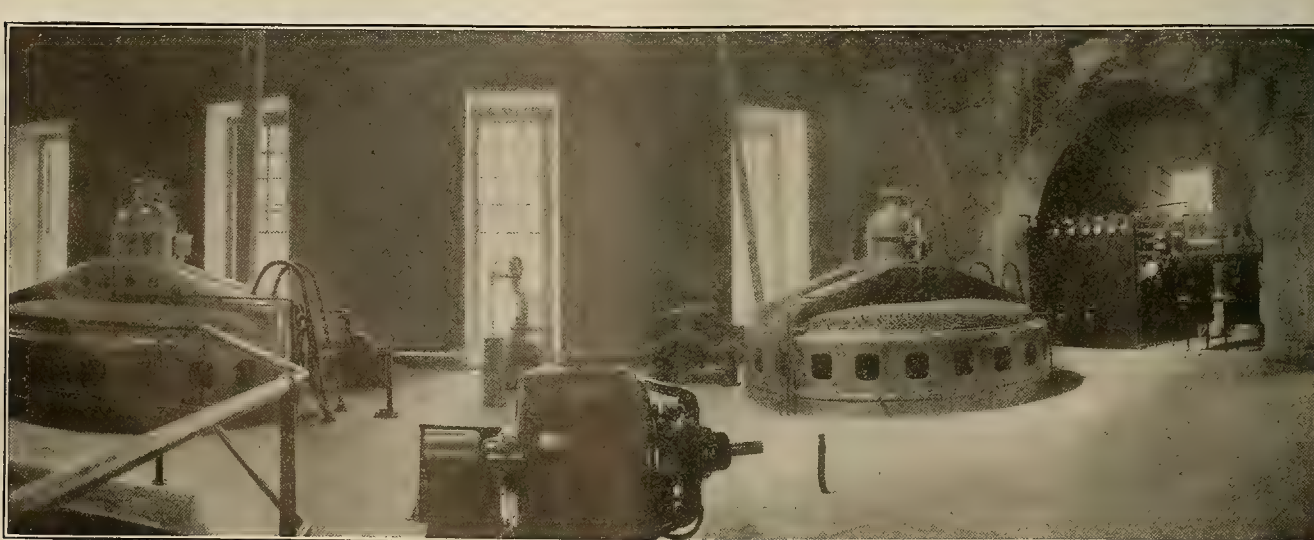
ONE of the two California State Prisons is situated two miles east of Folsom on the south side of the American River, a tributary to the Sacramento and having its source among the high altitudes of the Sierra Nevada range. The prison nestles in the foothills which meet the valley but a short distance to the west.

In 1866 a project was inaugurated to develop a manufacturing center at the town of Folsom, utilizing the power of the river, due to its fall between the town and the site of the prison, and work was commenced on a dam in the canyon of the river at the prison site. Twenty years of unsuccessful negotiations passed before a final arrangement was made to proceed with the work by convict labor. In the meantime the state had received title to the land upon which the prison now stands, together with the surrounding farm, also a right to use of a fall in the canal of 7.33 ft., to produce power for uses at the prison. The state then erected a power house across the canal in which were placed six vertical turbines of 75 h.p. each, the shafts of these driving a horizontal jack-shaft through bevel gears. From this jack-shaft were driven by rope drives, a two-cylinder single stage air compressor of slow speed and great size, having a nominal capacity of 2000 cu. ft. of free air per minute; also an horizontal 3-throw plunger pump with a capacity of 960 cu. ft. per min. operating at 10 r.p.m. This also was a huge affair. A machine shop and ice-plant were also driven from this jack-shaft.

The prison plant was built in 1891, and the construction of the canal was continued to the town of Folsom. In 1893 the plan of Horatio P. Livermore, who, with his brother Charles had been the moving spirits in the proposed power development since its inception, to generate electric power and transmit it to Sacramento, began to take form. After many trials and vicissitudes the electric plant at Folsom was completed and the famous Folsom to Sacramento transmission, the pioneer of power transmission systems in America commenced operation on July 7, 1895. The water to drive this plant, after leaving the dam, follows the canal for a quarter of a mile, then passing through the turbines at the prison plant, continues for a distance of 1½ miles to the Folsom plant, now one of the fourteen hydroelectric generating plants of the Pacific Gas & Electric Company. In 1906, two of the vertical turbines in the prison powerhouse were removed and in their place was set a double horizontal turbine having a nominal rating of 150 h.p. In 1915 the State Legislature made an appropriation for the construction of a new hydroelectric plant at the prison of sufficient capacity for the needs of the prison for many years.

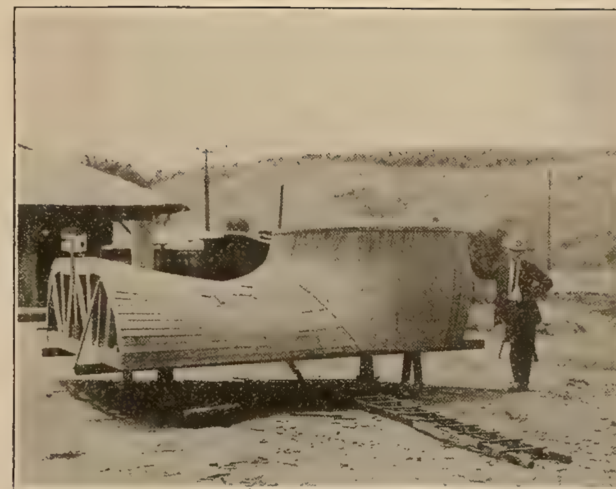
The problem presented in the design of a power plant was somewhat difficult, due to the many severe controlling conditions where the limits in type and capacity were more or less interdependent and all closely circumscribed by these controlling conditions. The use of the old turbines and jack-shaft was out of the question, for besides being worn out and sadly inefficient, the capacities were too small. The slow-speed air compressor was in much the same class, except that its capacity was much too great for the needs of the prison while the triplex pump was in the last stages of its usefulness and archaic in its antiquity. Furthermore it would not supply sufficient water for the uses of the prison.

During about nine months in the year, there is sufficient water in the American River to operate the Pacific Gas & Electric Company's plant at the end of the canal line, which is more than enough for the present and probably the future needs of the prison. During the remainder of the year, the river's flow dwindles until in most years it will not exceed 100 cu. ft. per second. With a canal full of water flowing, and the water level above the prison plant at the spillway line, the difference in water level above and below the prison powerhouse is actually 8.5 ft. During the period of low water flow, while the canal above the prison powerhouse may be kept full, the tail water level falls until the difference in head may be as great as 12 ft. In other words, the variation in head on the prison turbines may be almost as great as 50 per cent of the normal head. It was found that the probable uses of the prison would require a plant which would deliver continuously not less than 400 h.p. The old granite flumes which extend underneath the powerhouse and in each of which was placed originally, one of the 75 h.p. turbines, were found to have a flow capacity for about 300 sec. ft. within the limits of good practice for maximum allowable velocity. A turbine placed in each of two of these flumes would give together, the required power. To design a turbine to operate under a head, which might be as low as 8 ft. and handle such a quantity of water meant a structure of extremely low speed and a diameter too great to be placed in the flume and still leave space for good water entry. The lower the speed adopted meant the greater the weight and diameter of the generator if direct connected. In any case a runner design for high specific speed and consequently great water capacity was essential. After equating all of these conditions, it was decided to adopt a runner of 51 in. mean diameter, operating at 100 r.p.m., having a nominal shaft horsepower of 215, while operating under 8.5 ft. head with a flow of 285 sec. ft. The design of the turbine was such that while the power output increases more than 50 per cent when the head is increased to 12 ft., the efficiency also increases several per cent. This works in nicely with the plan of operation, for, when the head is low, there is ample water and the slightly lower efficiency is not a detriment, but when the head is high, the quantity of water is limited and the greater the amount of power available from the water flowing, the less of standby power there is to be purchased. For during the three months of low water flow, it is not expected that sufficient power can be generated for the prison uses and the standby service must be utilized.



Panoramic View of Power Plant

One of the Turbine Runners; Weight 4 Tons



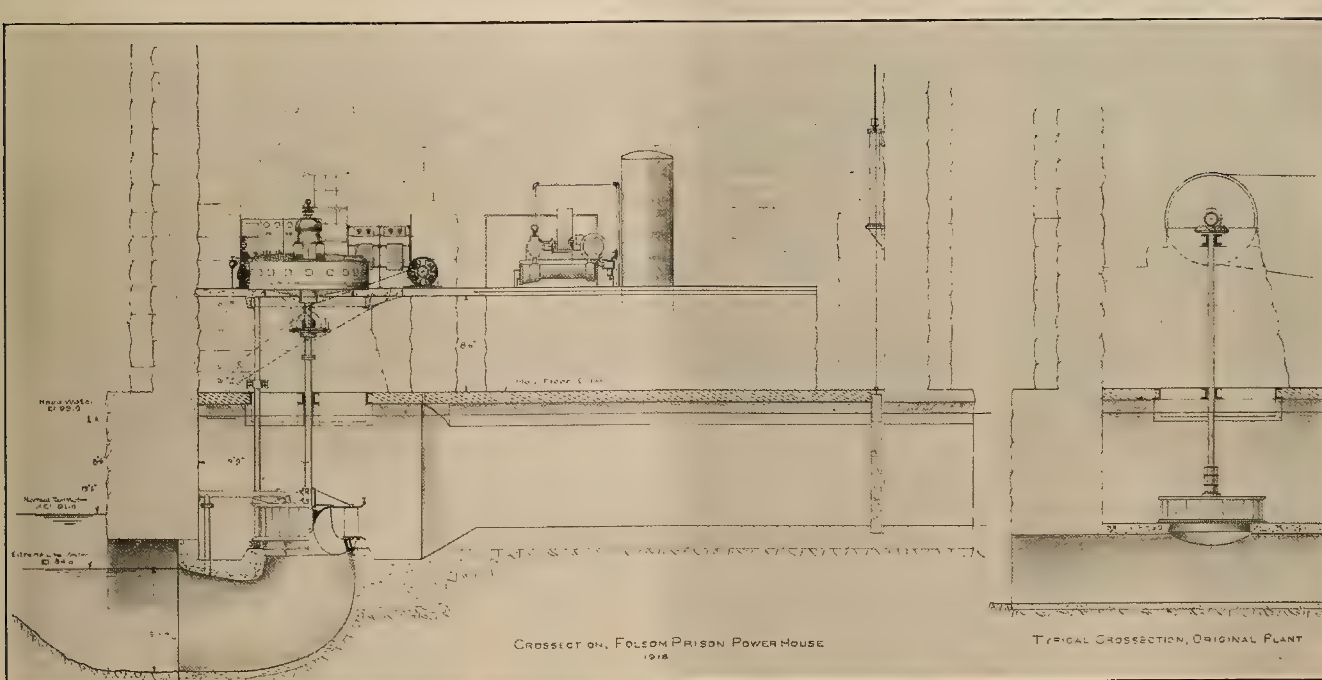
Form for Upper Half of Draft Tube

Under normal operating conditions the turbine runners are lower than the surface level of the tail water, hence the greatest care was exercised in the design of the draft tubes which are formed in concrete.

All idea of mechanical drives for compressor pumps and ice-machine was abandoned, because, in the first place, new machinery was essential to maintain the prison service, the old apparatus being long past the period of dependable operation, and secondly because with modern machinery, any mechanical drive would have been awkward, expensive and inefficient. Hence the determination to drive all machinery by induction motors.

The plant as finally determined and built consists of two vertical main generating units. The main powerhouse floor is an 8 in. slab of reinforced concrete placed at a level 9 ft. above the main floor of the building. This was necessary, partly to accommodate a jack-shaft between the two turbine shafts and partly to provide head room between the main floor and the generator floor. The generators are necessarily machines of special design because of the low speed and unusual small capacity for machines of this speed. The stator is of a conventional type for a vertical machine and is supported on a castiron ring which rests on the floor slab. The winding is of the ordinary distributed type. The rotor has a castiron spider which, beside being held by two keys to the shaft, is split on one side and has two cinch bolts so that by no possibility can the spider slip down on the shaft. The 72 pole pieces are bolted to the face of the spider rim. The rim is heavier than necessary for required strength, this being done to add weight, the moment of inertia being required to be 80,000 ft.-lb. for purposes of proper regulation, or, in other words, to give added fly-wheel effect. The generator shaft extends upward to provide for the suspension, or thrust bearing.

Protection on either side of the yoke to the windings and to obviate the danger of a person falling into the moving spider is had by heavy wire nettings which have sufficient stiffness to hold the weight of a man. Neat iron steps make a safe passageway for the operator when attending the brushes or thrust-bearing.



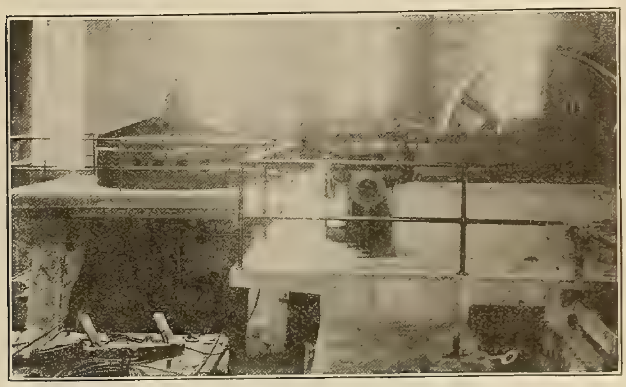
Crossect on, Folsom Prison Power House 1916

Typical Crossection, Original Plant

The generators are wound to deliver 2300 volts, 3-phase current. The nominal rating is 200 k.v.a., the specifications calling for heating guarantees in accordance with the rules of the American Institute of Electrical Engineers. The machines were also tested for a runaway speed of 200 r.p.m., or 100 per cent overspeed, which is a condition of runaway speed that might occur when the turbines were operating at a maximum head of 12 ft.

The generator shaft extends 6 ft. below the generator floor level terminating in a forged flange and to this is bolted by ten 1⅛ in. bolts, the similar forged flange of the turbine shaft. Both of these shafts are 7 in. diameter.

The total weight carried by the thrust bearing is 19,000 lb., to which must be added the hydraulic thrust of the runner of 6000 lb., making 25,000 lb.



Air Compressor, Power Plant in Background

total load. This is divided as follows: rotor, 7400 lb.; runner 8000 lb., shafting 3600 lb., thrust 6000 lb.

The two vertical steady bearings are oiled from a glass drip cup having capacity for 0.6 gal. lubricating oil. The oil passes down through the bearing and the drip is caught in an annular castiron cup and drains through a pipe, fitted with a sight-gauge, which is carried around the rotor to the upper side of the lower bearing, passing through this, it is again caught in a similar annular cup and drained into a tank, from whence it is used over again, after being filtered. To prevent the oil following the shaft, after passing through the bearings, there is provided between the lower end of each bearing and the annular cup, a baffle ring which solidly clamps the shaft, thereby deflecting the oil into the cup.

To provide a constant draft of air into the windings, there are bolted to both sides of the rim of the rotor spider, directly under the field poles, sheet-steel fins which project forward in the direction of rotation at an angle with the rim side of 50 deg., these acting as fans.

Current for excitation is provided by one 30 kw., 125-volt shunt wound generator. This machine is a standard type with end-bell bearings, four field poles and two interpoles. The speed is 1200 r.p.m. and the shaft at one end is equipped with pulley for belt drive and at the other is extended to carry a coupling for direct connection to the shaft of a 40 h.p., 2300-volt, 3-phase, 1150 r.p.m. induction motor.

A horizontal jack-shaft extends between the vertical shafts of the two turbines, its speed being 300 r.p.m. Upon each end of the jack-shaft is mounted a rawhide bevel gear and these are driven from the turbine shafts by castiron bevel gears having split hubs being mounted on the turbine shafts. As it is intended to drive the jack-shaft from either turbine, but not from both at one time, there are two sliding jaw clutches operated by levers which extend above the generator floor. This arrangement divides the jack-shaft into three sections, there being two bearings to each section, or six in all. In the design of the jaw clutches, an interesting problem arose. In throwing out one clutch in order to engage the other, with both turbines running, so that the central part of the jack-shaft would not lose its driving power and thus stop turning, it must be possible to momentarily engage the idle clutch, before disengaging the running clutch. The generators operating in synchronism, there are 36 points of relative position between the two rotors, any one of which relative positions may take place when the machines are synchronized. As the bevel gears have a ratio of 3:1, there are therefore $36 \div 3 = 12$ positions in a jaw clutch when the two halves of the clutch might engage. In order then, that the incoming jaw clutch may always be in a position to engage, the jaw clutches are built with 12 radial jaws.

The object of the jack-shaft was to furnish by belt drives the power to drive the exciter, the oil pump furnishing oil under pressure to operate the governor and to drive the governor head. Two exciters could have been used, each connected to one turbine shaft, necessitating a motor drive for the governor pump and two governors. The added complication and cost were not considered justified for the following reasons. In case of belt or exciter failure, one of the more remote exigencies, the induction motor is available to drive the exciter, and if necessary, this power may be transmitted back through the exciter driving belt to drive the jack-shaft and through it the oil-pump and governor head. This induction motor may be supplied with current, either from the station bus, or from the standby service which is always available. In case of further emergency, the standby service may be instantly thrown onto the station bus.

The turbines and jack-shaft mechanism were built by the S. Morgan Smith Company, while the generators and exciters were furnished by the Allis-Chalmers Manufacturing Company.

One governor controls both turbines. This, together with the hand regulating mechanism was built by the Woodward Governor Company. The governor with full oil pressure of 200 lb. per sq. in. has a duty capacity of 10,000 ft. lb. It is so arranged that both turbines may be controlled by the governor, or one turbine by governor and one by hand, or the reverse connection, or both by hand. A very ingenious device is used to accomplish this. The governor proper stands on the station floor, midway between the two generators, the operating cylinder being horizontal and close to the floor. The piston rod of the operating cylinder extends through both heads. Close to either generator, and in line with the direction of motion of the governor are the two handwheel mechanisms which are mounted on a cast iron frame that carries the cross-head into which

the piston rod is fastened, an arm of this frame which is flush with the floor carries at its extremity, a ball thrust bearing and passing down through the arm and supported by the thrust bearing is the rotating gate shaft which operates the turbine gates through push and pull rods at the lower end of this shaft. Above the thrust bearing and keyed to the gate shaft is a bell crank and this is operated through two links from the cross-head. The handwheel is on top. Its vertical shaft carries a spur gear which engages a pinion for the purpose of a gear motion reduction. The pinion shaft carries another pinion which engages a rack on the back of the cross-head. The hand wheel rigging is contained in a housing integral with the main frame, but is mounted on an eccentric which is moved by a lever fitted with a hand pall. By this means the handwheel mechanism may be thrown out of gear in reference with the cross-head. On the handwheel shaft is a brake operated with a small crank. The piston passes through the cross-head freely, but engages the cross-head by means of a spring bolt operated by a swinging handle. While governing, the spring bolt is in and the handwheel mechanism by means of the eccentric is entirely out of gear. When operating by hand, the pin is pulled out and the eccentric thrown in and the brake is used to hold the handwheel where desired. The turbine gates are designed to be so balanced as to have an opening tendency up to 0.4 load and a closing tendency above this point. While the gates and mechanism are heavy, one man can handle the gates without difficulty, while the governor moves them easily with an oil pressure as low as 60 lb.

There is a four-panel black slate switchboard furnished by the General Electric Company, fitted with all necessary indicating and recording instruments for two generators, three outgoing feeder circuits and one incoming 2300-volt, 3-phase standby service supplied from the power station of the Pacific Gas & Electric Company, located at the lower end of the canal. There are also three motor starter panels, one of which controls a 75 h.p. induction motor which drives the pumps supplying the prison water system, one controls a 100 h.p. motor which drives an air compressor, and the third will control the 40 h.p. motor used as reserve drive for the exciter.

The air compressor is mounted on an extension of the generator floor and is supported over one end of the massive stone foundation which originally carried the old air-compressor. This compressor is the "Imperial," high speed two-stage type furnished by the Ingersoll-Rand Company, the displacement capacity is 600 cu. ft. free air per minute, at a pressure of 80 lb. per sq. in.

Although electric current contributes to the cause of only a small number (8%) of the accidents in the electrical industry, it causes the largest number of serious and fatal accidents to employes and, therefore, this cause is worthy of the first consideration. All employes whose duties require them to work about electrical lines or equipment should use all of the safety appliances provided, and should take every possible precaution to prevent electrical contact.

OZONE FOR THE CHILDREN—I. OR ENGINEERING TWISTERS RETOLD.

Said he, "Immediately upon graduation I started to run down a job. Having in vain exhausted my supply of local acquaintanceship along engineering lines, I next decided to tackle the great handlers of electrical machinery, so I went to the General Electric and having told them what experience I had previously had in electrical installation, the manager of the local office offered me a position at a salary of $1000 per annum with an annual increase of $200, operative at the end of the first year. Having been given 24 hours in which to return an acceptance or rejection, I then turned to the Westinghouse Company who offered to give me $1000 per annum with an increase of only $100 per annum, operative, however, every six months in installments of $50 beginning at the end of the first six months."

Everybody at the table began to show signs of intelligence looking to the conclusion of his story by assuming of course that he accepted the first offer without delay.

At this moment, however, the young engineer said: "So, of course I accepted the last offer, which proved to be better than the first by $50 per annum for every year of my life."

This is seen to be the case by a detailed analysis as follows:

First Offer.		Second Offer.	
1st 6 months	$ 500	1st 6 months	$ 500
2d 6 months	500	2d 6 months	550
Salary 1st year	$1000	Salary 1st year	$1050
2d year, 1st 6 months	$ 600	1st 6 months	600
2d year, 2d 6 months	600	2d 6 months	650
Salary 2d year	$1200	Salary 2d year	$1250

The reason for this is seen to be that the second proposition is in reality a compound increase every six months and although at an annual increase of only $100, by compounding every six months, it exceeds an increase of $200 per annum on the annual basis.

POLE SETTING IN SAND.

A novel and effective means has been found for digging holes for the poles of the new transmission line which the Southern Sierras Power Company is building across the desert from El Centro, Cal., to Yuma, Ariz. The sand is so fine and dry that it runs almost like water. To obviate the difficulties of digging under such conditions the engineers of the company have devised a collapsible cone, which tends to sink into the ground by the weight of the sand and at the same time keeps the sand out.

A frustrum of a cone in about the proportions of an 18 in. top, 36 in. base and 72 in. height, is made of galvanized iron sections hinged so as to collapse inward. This is placed on the ground and as the sand is excavated it quickly sinks into the hole. It is then collapsed, an iron cylinder dropped inside, the cone is withdrawn and the pole placed in the cylinder, sand being shoveled into the surrounding space to hold the pole in position.

The purpose of the cylinder is to protect the pole from the effects of the drifting dunes characteristic of this country.

PROPER BUSINESS METHODS

BY C. F. BUTTE.

(The question of cost keeping is one of vital importance to the contractor and dealer. Here is a timely paper recently presented before a meeting of the Electrical Jobbers, Contractors and Dealers' Association of San Francisco wherein the author, who is a prominent electrical jobber of that city, forcefully presents the fundamentals to be observed by the contractor and dealer in the business management of their organization.—The Editor.)

Two hundred thousand firms out of two hundred and sixty thousand firms engaged in business in the United States are merely eking out an existence. One hundred thousand of them have not earned a penny is the report of the Federal Trades Commission after surveying the field for a period of one year.

Out of 60,000 successful firms doing a business of approximately $100,000 a year, 30,000 of them charged off no depreciation whatsoever. Only 10 per cent of the 260,000 firms know the actual cost of handling and selling their products. Forty per cent of them merely estimate their cost and 50 per cent have absolutely no idea of their cost, but merely haphazardly guess and establish their costs arbitrarily Invariably this 50 per cent of the firms establish their cost and prices on the basis of the selling price of his competitor and with this knowledge as a basis they invariably cut prices, demoralize the business in which they are engaged and create a further ruinous condition as their competitors again use the information and selling price established as a basis for establishing new prices and costs. In other words Firm A will use the prices of Firm B to establish his prices, whereupon Firm C will use Firm B's prices to establish his price and so on down the line.

Is it any wonder to you, gentlemen present, that a demoralizing condition exists in many business lines when the Federal Trades Commission finds these existing conditions in their inevstigations?

May we hope that some day all business firms will be gradually extended the helpful machinery of the government as is now done by the Interstate Commerce Commission to the railroads and shipper, by the Railroad Commission of California to the public service corporations, by the Department of Agriculture to the Fruit Growers, Farmers and Dairy Producers' Association and by our recent market commission to the farmers and producers of California.

However, while we are awaiting the day of governmental support and control, what are we to do to helpfully aid and correct the immediate situation?

Well may we say that associations such as our association, the California State Association of Electrical Contractors and Dealers and many similar organizations realize that education and education of its members are the only available means wherewith to correct the present existing evils.

Not by forming any combination to fix prices, not by any pools to gamble on contracts, not by any cliques to add arbitrary additions to bids or proposals, but by the slow, difficult and tedious method and process of educating the members how to do business, how to keep proper records of costs, how to properly estimate values and quantities do we hope to drag ourselves out of the 50 per cent class and out of the 100,000 previously referred to and mentioned in the Federal Trades Commission Report.

However, while the membership of the particular craft organizations are gaining knowledge concerning their business affairs, we have still to contend with the non-members within the 50 per cent class and the 100,000 and who follow the process of A and B and C previously mentioned, many of whom cannot, will not and do not gain any knowledge or training without the hard knocks of failure and bankruptcy, of which there were 22,000 last year, unless the governmental aid comes forward and carries into effect and force some of the recommendations of the Federal Trades Commission—one of which is—That all firms must be members of their respective craft organizations.

In a very recent report issued by the Federal Trades Commission, the following portion under a heavy type caption appears—Many Businesses not Profitable.

> A large proportion of businesses are not making the money they should. A great number of them are actually losing money. The purpose of conducting a business is to make money, and the only way to make money is to sell something for more than it costs. The first essential, then, is to know the cost. It is the belief of the commission that the small margin of profit existing in so many of our industries is due to the ignorance on the part of the firms of what their goods actually cost to produce. This ignorance causes them to make unprofitable prices, which the firm who does know his cost is forced to meet to a large extent.

It is a fact too little realized that an accurate determination of cost is fundamentally related to efficiency and proper business methods.

The ranks of those who fully realize the necessity of a proper cost is filling up day by day and every recruit joining the ranks can feel that he is doing his part of the work towards the improvement of business conditions generally and particularly his own.

Again quoting from the report previously mentioned:

> Cost is defined as the amount or equivalent paid, or charged or given for anything; loss of any kind, expenditure, outlay, as of money, time, labor.
>
> This equivalent may be in the form of money paid for material or for labor, or for some one of the many kinds of expense or loss that exist in every business. It is apparent that cost consists of three elements, viz, material, labor and expense.
>
> The problem is to ascertain the amount of each of these elements, and in order to accomplish this in the simplest and most practical manner the firm has recourse to system. System is defined as a regular method or order, a formal arrangement, or a mode of operation governed by general laws or rules.

In the past many firms disliked to give out information concerning their business. Today the reverse is the case. Trade associations are compiling statistics as to production, shipments and costs for the benefit of their members, and the manufacturer instead of trying to keep this information to himself welcomes the opportunity to supply the data, knowing that his competitors are doing the same thing and that these statistics will be of benefit to himself and to his industry.

The commission is urging manufacturers to determine their costs accurately in the interest of better trade conditions. It believes that anything that is of benefit to an industry is of benefit to the public, and it is also of the opinion that the nearer cost systems approach uniformity the more valuable will be the results.

During the past ten years the best accounting brains in the country have been devoting a great deal of time to the perfection of general laws or rules which will give the desired results with the least effort and expense, and the outcome of their work is what is known as a "cost system." This provides not only for the determination of the amount of each element of cost properly chargeable to each job or operation, but also provides for an improved method of bookkeeping which causes the books to reflect at all times the true financial and industrial condition of the business and renders possible the preparation of monthly statements of conditions, as well as complete monthly statements of financial operations.

Cost system or means whereby we determine the cost of our work is the vital part of our entire existence.. Without a proper cost, a proper proposal cannot be made and without a proper proposal a proper return for our work cannot be had:

The first element of cost is material. Material is of two kinds, direct and indirect. Direct material is that which forms part of some particular job and can be so charged. Indirect material is that which can not be located as belonging to a particular job, and which is more in the nature of general supplies. This class of material is sometimes termed "expense material," as its ultimate destination is the expense account of some department.

The second element of cost is labor, and this, like material, is divided into two classes—direct, or, as it is sometimes called productive labor, and indirect, or nonproductive labor. Direct labor is that which is applied directly to the job and which can be so charged. Indirect labor is that which can not be located as belonging to any particular job, but must be charged to the expenses of some department.

The two elements of cost are fixed in all cases by the specifications and plans and can be determined by proper estimating methods whereby quantities of materals and kinds are computed and the labor itself estimated accordingly.

We now come to the third element of cost generally termed Overhead Expense or sometimes "Burden," too often in the past a "burden" on the contractor's illusive imaginary profit:

Overhead expenses is the expense of every kind connected with the business, none of which can be directly located as belonging to a particular job. These expenses, while part of the cost of a job, are general; hence a method must be devised for them to reach the cost sheet in an indirect manner, the method at the same time being so planned that each job will receive its fair proportion of the total.

To determine the proper proportion each job must bear of the overhead expense, you must again realize the absolute necessity of keeping a proper cost in your business. In order that you may more fully appreciate what may come under this head, I will transgress a few minutes and list some of the items that should be listed and charged thereunder:

In spite of the continued emphasis placed upon the necessity for considering overhead expenses in determining the cost of construction work, the custom still persists among many inexperienced contractors of neglecting this item. It would seem that no man could remain in business very long without realizing the existence of this item of cost and the necessity of including it in his estimates of the expense of contemplated work. Yet evidence frequently comes to hand that contractors are doing this very thing. To succeed in business the contractor must not only realize that overhead expense is an essential element in the cost of doing his business, but he must know how to determine what it amounts to in his own particular case. The contractor who does not keep his cost figures in such shape that he can tell what his overhead expense actually is, is engaged in a gambling operation, and sooner or later fortune is likely to be unkind to him. In the meantime he is a disturbing factor in the business and does an injury not only to himself, but to his fellow contractors.

The items that generally constitute overhead expense and that should be listed thereunder are as follows:

Rent.
Light, power and heat.
Advertising.
Attorney fees.
Freight, express cartage.
Association dues and subscriptions.
Periodicals, newspapers and reports.
Postage.
Printing and stationery.
Stockroom miscellaneous supplies.
Telephone and telegraph.
Automobile maintenance and supplies.
Commissions not chargeable.
Interest and discounts.
Insurance.
Taxes.
Defective work and repairs.
Tool repairs and losses.
Preliminary expense on jobs not secured.
Superintendence.
Executive expense.
Entertainment expense.
Depreciation of stocks and equipment.
Stock wastage and losses.
Wagon and truck maintenance and repairs.
Office supplies.
Clerical and bookkeeper payrolls.
Stockkeeper's payrolls.
Drivers' payrolls.
Bad debts.

Many of the items that have been mentioned are self-explanatory, however, several should be further elaborated and which I shall dwell upon as briefly as possible.

I will first take up the item of interest that may seem exceedingly insignificant to many, but upon further analysis you will readily agree that this item is a very important one in your overhead expense.

How many present have ever studied the average amount and value of work that is held back on contracts and for which you have invested your capital and the average length of time your capital is thusly not earning anything for yourself? The average contract provides payments of 75 per cent of the value

of work installed in the building, but how often and how long have you materials in your stock room or warehouse that you cannot install owing to the building operations over which you have no control and for which you receive absolutely no payments?

In comparing 35 contracts ranging in sums of $325 to $6500 the average length of time for completion and acceptance is 10¾ months; 10¾ months you have approximately $8500 of capital tied up and at ordinary bank interest of 6 per cent this would amount to $510.

In addition to this item of interest you also have approximately a stock of materials valued at $3000 laying in your stockroom and at 6 per cent on this valuation the interest would be $180.

You can readily see from the previous figures that this one item amounts to approximately 1¾ per cent overhead on a gross annual business of $45,000. This ratio will hold true for any volume of business that may be performed. I have not mentioned any interest on borrowed capital or notes with your banks as I presumed that very few of us have any of these two items.

Depreciation is another item that many fail to place proper consideration thereto and again quoting the Federal Trades Commission depreciation is one of the most important of all overhead expenses:

> One method of handling depreciation, which is unqualifiedly condemned although extensively used, is to wait until the end of the year and then if the profit and loss statement shows that a good profit has been earned to charge a part of this profit to depreciation. If, on the other hand, the profit and loss statement shows little or no profit, nothing is charged to depreciation. It is difficult to understand how any practical man can take the view that his stock and equipment have not worn out because he has not made a profit, and at the same time have worn out when he has made a profit.

How many contractors do consider the item of depreciation? If not—why not? Do you believe any business house or jobber that is showing actual profits omits this item?

Another item invariably, perpetually and negligently overlooked is the item of superintendence and executive expense. How many contractors ever give this item any consideration? Do you believe that a contractor should give his time for nothing when personally handling work? Do you believe that a bank gives you the time of the president or cashier for nothing when they charge you 6 per cent interest on money borrowed and no per cent for handling your account? Emphatically no!

Do you believe that the manufacturer gives you the time of himself in making his prices for materials he sells to you through the jobber and which you pay for? Emphatically no! Again no, as all obtainable reports and information shows that the personal drawings and salaries of these officials are charged to overhead under superintendence and executive expense. Then why in the name of God's green country does the contractor give his time away without charging it up to overhead expense and adding it to his cost of doing business?

Are you all so willing to give time away without return? Are you all so willing to come under the head of the 200,000 and merely eke out an existence? Then why continue and do what was very adaptly expressed in one of our earlier papers in these words, "Why does an electrical contractor invest $1000 or $20,000 in supplies and equipment and then work himself down to white hair and a five cent cigar just for the glory of paying rent and being called a contractor?

Tabulated reports show that the average cost of doing business under the classification of electrical contractor is 32 per cent of a gross business of $20,000 annually. For a gross annual business of $60,000 the average overhead expense is 17½ per cent. The overhead expense for a concern doing $45,000 annual business the percentage runs average 26 per cent. Bear in mind at all times that your overhead expense is based on your gross annual business and never on your net cost of material and labor.

Think it over carefully and do you wonder why the electrical contractor has not shown any real profit in his business when these percentages stare us in the face? These averages are not only based on reports from our state association, but on our national organization reports as well.

I will now come to the most abused, most unconsidered, and most important fact connected with our business and that is profit.

Have you heard of firms doing a good business, flourishing in all departments and making money with their reports showing a 12½ per cent net profit? Yes, such firms exist and in order to make a 12½ per cent net profit with an overhead expense of 25 per cent such firms add 60 per cent to the cost of material and labor or the actual cost of their product. With a 20 per cent overhead it is necessary to add 50 per cent to the cost of labor and material in order to make a net profit of 13 1/3 per cent. Yes, only 13 1/3 per cent net profit when you add 50 per cent to cost with overhead at 20 per cent.

The average electrical contractor has an overhead expense of 22 per cent. Adding 25 and 20 to your cost only nets you 11 1/3 per cent net profit. Is there any architect, owner or engineer that would disagree with the statement that a contractor should at least earn 11 1/3 per cent net profit for his capital invested, for his engineering knowledge, for his labor handling problems, for his merchandising ability, for his salesmanship and executive ability, for his responsibility and for his business qualifications?

Again reverting to the 200,000 and in conclusion:

> Of bookkeeping I knew nary a line,
> Of credits and finance the same;
> But still, I went into the business
> Of wiring— a wonderfully easy game.
>
> I never considered such trifles as rent,
> And taxes and insurance, thought I,
> Were small considerations after they were spent.
> My profits would show bye and bye.
>
> What knew I of overhead expense,
> Or the items of which it was made?
> They told me it was at least 34 and six-tenths,
> The monthly amounts which I paid.
>
> There were thirty-nine reasons all together
> Why I failed and was put on the "run,"
> The thirty-ninth and most important was—
> I should never have begun.

Toppled Tower of Southern Sierras Power Co.

Wires Down Along Pole Line of Nevada-California Power Co.

A Cross Arm That Failed.

(The great power lines of the West are constantly exposed to severe atmospheric conditions. Here are some views, just taken, showing in a striking manner how sleet and snow have recently damaged transmission systems in the high Sierras.—The Editor.)

NEVADA TRANSMISSION LINES DAMAGED BY STORM.

The disastrous effects of sleet on high tension transmission lines is graphically portrayed by the accompanying pictures of portions of the lines of the Nevada-California Power Company and the Southern Sierras Power Company. These lines lead from hydroelectric plants close under the eastern scarp of the Sierra Nevada Mountains to supply power to the mines of Goldfield, Nevada, and the orange groves of Southern California.

Late in December, 1916, they were subjected to unprecedented storms of snow and sleet. The sleet froze as it touched the wires, soon forming a cylinder of ice weighing three pounds or more per foot of wire, some of the wires being six inches in diameter. The dead weight of the ice-covered wires together with the strain of a fifty mile wind caused a number of towers to fail, thus interrupting the power service.

The towers carried two circuits with 660 ft. span, these with the ground wire giving a load of at least six tons.

The towers were designed with a factor of safety of 2 to withstand the weight of a one-half inch coating of ice and a wind velocity of 75 miles an hour. To anticipate constructionally the unusual strain to which these towers were subjected would not have been financially possible. It is cheaper in the end to repair such damage as it occurs.

It is of interest to note that no two towers failed in the same place. One was buckled by the weight, the cross-arm of another gave way, a third failed at the mast, while yet another was completely toppled over.

A Crumpled Tower Base

Broken at the Mast

Ice Clad Guy Wire Compared With Foot Rule

SHORT JOURNEYS IN PACIFIC LANDS

(The trend of recent engineering and commercial development looking toward closer relations with our foreign neighbors has leaned toward the formation of home corporations with sufficient financial backing to properly enter the foreign field. Below is an interesting announcement which shows by special instance this recent phase of evolution in our national life.—The Editor.)

CLOSER ENGINEERING AND COMMERCIAL RELATIONS WITH ARGENTINE.

Indicative of the increasing commercial and engineering relations with South America may be cited the recent meeting of leading manufacturers of the United States at the Manhattan Hotel in New York City. This meeting was held to perfect the organization of the Argentine Mercantile Corporation which marks the success of efforts by the American manufacturers for the past six months to form a coalition for the purpose of marketing their goods in the rich Argentine country, under the first workable co-operative plan ever attempted for exporting goods from this country.

Coincident with the announcement of the plans of the Argentine Mercantile Corporation made, it became known that the organization has been incorporated in Virginia, with a capital of $5,000,000, and that when the co-operative enterprise is fully under way it is expected that the bulk of this capital will be employed in marketing their goods.

The feature of the organization is that no competing lines of goods will be carried and that each manufacturer will bear a share of the expense of marketing his product in Argentine in proportion to the extent of his business. The corporation combines in one solid organization, the distributing, selling and financing of the merchandise of the manufacturers. It has taken for its salesrooms in the city of Buenos Aires an entire building in the center of the retail district, adjacent to the Plaza de Mayo, in Calle Defensa No. 140 to 148. Purchasing and forwarding offices are to be maintained in New York City until an adequate building in the water front district can be obtained to be entirely devoted to the purposes of the corporation.

Until then the manufacturers will use 3700 square feet of floor space in the Bush Terminal which has been taken under lease, and which space will be increased as rapidly as additional room can be obtained.

The building in Buenos Aires which is now being fitted up for the corporation, and will probably be occupied by next March, is being outfitted in a splendid manner for the display of the samples of the allied manufacturers. Each classification of trade will be exhibited in a separate department and each department will be in charge of an experienced manager, with a competent corps of salesmen and travelers experienced in the merchandise trade and customs of the Argentine.

In explaining why the allied manufacturers have chosen Argentine as a sole field for putting into effect their advanced views as to the proper method for obtaining South American trade, it was pointed out at the meeting, that the importance of the Argentine as a customer, and the assured commercial future of the country, will make it necessary for them to limit their scope to this country alone, and to concentrate their energies at Buenos Aires.

The importance of the Argentine as a customer for American made goods of every kind is shown by the fact that the imports to that country in 1913 were $421,352,542, and in 1914 were $271,817,900, a decrease of 35½ per cent. The imports in 1915 dropped to $226,892,733, a decrease of 46 1/6 per cent from 1913. During that three-year period the exports were $1,391,039,331, against imports of $920,063,175, leaving a balance of trade in favor of Argentine of $470,976,156, which is now awaiting expenditure. This amount is a per capita increase of $59 in the wealth of the country in three years. Of course this trade balance is largely due to the fact that the Argentine has been unable to buy in the European markets where it has been accustomed to trade, and the American market is an untried experiment to them.

EVIDENCE OF FOREIGN INTEREST IN ELECTRICAL AFFAIRS.

The following letter will undoubtedly prove of intense interest to readers of the Journal as an indication of the awakening attitude in foreign lands toward matter sent out through our columns. The letter is from Calcutta, India, and enclosed a clipping from one of our display advertisements:

6 Mangoe Lane, Calcutta,
November 17, 1916.

Messrs. The Pacific States Electric Co.,
San Francisco, U. S. A.

Dear Sirs:

I was much interested to see the enclosed advertisement in the Journal of Electricity, Power and Gas.

As far as I am aware motors for operating talking machines are unknown in India, but I do not see any reason why this useful novelty should not catch on in this country.

It is, however, essential that the machine should be small and handy and not too expensive for it to make headway here, as electricity is only provided in the large towns and in the houses of the rich, so the field is to a certain extent limited.

Will you therefore kindly send me all the literature available on the subject, your special sales proposition, weight, size, price C. I. F. Calcutta and in Indian currency if possible.

Also kindly let me know whether you are prepared to grant sole agency terms for the whole of India.

Yours faithfully,
C. W. HOBSON.

WATER POWER CONSERVATION IN CHINA.

The importance of future waterpower conservation is being agitated in China, although at present China possesses untold natural possibilities for water power development. Popular lectures on the importance of forestry to China have recently been given in Peking under the auspices of the Chinese Forest Service, of which an American, formerly Chief of the Philippine Bureau of Forestry, is co-director. The lectures have been given by a Chinese official of the service, who is a graduate of the Yale Forest School and has published valuable material in Chinese on the subject. They are accompanied by an exhibition of Chinese woods.

DISCUSSION ON ELECTRIC LOGGING.

The discussion on Electric Logging on page 40 of the January 15th issue of the Journal by Mr. F. D. Weber is so manifestly the result of a careless and hurried reading of the paper in question that I consider it only fair to call attention to some of the inconsistencies of some of Mr. Weber's statements.

In the first place it will be noted on page 21 of the Proceedings of the Eighth Annual Session of the Pacific Logging Congress that the figures upon which the costs in the paper are based are applicable strictly to only two camps in the Northwest which were studied in detail. The object of the paper was not to show, as Mr. Weber seems to suppose, that electric logging is the universal solution for all logging troubles, but to show how it figured out in these two cases. Mr. Weber's attempt therefore to make a general discussion out of the paper is not warranted.

Mr. Weber further states that he will "Endeavor to point out wherein many engineers and loggers familiar with logging conditions in the Northwest do not agree with him," referring to the following statements: "The first and most important final answer to the question as to which logging machine is most suited for a particular duty is represented by the dollar mark." Mr. Weber has not even quoted the passage correctly as a reference to page 20 of the Proceedings of the Logging Congress will show. Mr. Weber seems to have some peculiar idea in that line, but it is certain that the engineering success of a project is measured by its ability to earn a return on the money invested, and that is all that the statement which he criticises means.

Mr. Weber further states "It would be necessary to furnish at least 350 kw. of capacity for each logging donkey." In other words, following his line of argument, a generating plant to supply the city of San Francisco would have to be built with a capacity equal to the sum of the instantaneous peak loads of all the customers of San Francisco, regardless of the time at which these peaks occurred. It is a little difficult to see by what line of reasoning Mr. Weber gets his authority for omitting all consideration of diversity factor. A careful study of the paper in question will reveal the fact that the figures are given as plainly stated in the article in dollars per donkey when considering an installation of five machines, thereby taking advantage of the diversity factor of such a load combined with the electric sawmill load. On this basis 35 per cent of the cost of an $80,000 power plant is set aside to be charged against the donkeys. Using Mr. Weber's figure of $65 per kw. this will supply a 1250 kw. plant to drive the electrified sawmill and take care of the five donkeys. At this point it must be emphasized that the figures given were secured by examinations of particular projects and it would be entirely possible, of course, to build a sawmill that would require a greater capacity than this.

Considering the diversified load of the sawmill of which a great many recording watt-meter charts have been taken in a study of this feature of operation and the fact that in the operation of five logging donkeys in the woods it is very seldom that more than two are in operation at the same time, and further that the 350 kw. demand spoken of by Mr. Weber occurs only for a few seconds, the weakness of his statement is at once apparent. The apportionment of the charges in the paper discussed were made after a careful consideration of all these factors and the instantaneous over load capacity of the generator, and while it is not even hoped that the figure arrived at is exact it is certainly much closer to the actual conditions than Mr. Weber's statement implying that the maximum capacity of a plant must be equal to the sum of the maximum demands occurring regardless of when they occur.

I know of no basis for the following statement, "We understand that Mr. Peaslee's figures are for one donkey plant equipment instead of five as stated in his paper." A reference to page 21 of the Logging Congress Proceedings will show that this situation is fully explained as stated above.

Referring to Mr. Weber's transmission lines, his statement that ten miles per donkey is a conservative estimate would mean fifty miles of transmission line to furnish the five donkeys. The figure of 3.2 mile per donkey indicated by the article referred to was arrived at by study of the locations for two years of the donkeys in the two camps under consideration and was ample for these camps. Of course the amount of transmission line required for any given case should be taken in discussing that case and general figures are not applicable.

Mr. Weber's ingenous showing that the power costs based on 1.5 cents per kw.-hr. are not permissible rather loses force when it is learned that the managers of two of our power companies of the Northwest have offered the author power contracts for combined sawmill and logging operation that meet this figure and in one instance where it was possible to operate a synchronous motor for power factor correction the rate offered was considerably less than this. On page 12 of the Proceedings of the Fourth Annual Session of the Logging Congress an offer was made by the assistant general manager of the Olympic Power Company of power at an equivalent rate of 1.5 cents per horsepower hour. It is hard to believe that the men managing and operating these companies are going to take any business that will not at least develop into a profitable load. The power rates quoted by the author were made after a thorough consideration of the load factor characteristics of several electrically driven sawmills and the Potlach Logging Donkeys.

With regard to Mr. Weber's emphasis of the fact that there is no electric logging of fir timber carried on at this date and his contention that therefore the author's statement that the electric donkey will handle 25 per cent more logs in a given time than the steam donkey is purely speculative, reference should be made to the Proceedings of the Fourth Annual Session of the Pacific Logging Congress wherein several men of considerable experience stated this feature emphatically. If the electric donkey, in handling pine, will handle logs 25 per cent faster than the steam donkey, is it so unreasonable to assume that approximately the same ratio of operating speed can be obtained with proper design in handling fir? Mr. Weber's statement that this assumption is purely speculative hardly indicates a careful study of the logging literature available.

Regarding Mr. Weber's criticism of the proposal that cables might be bought on a guaranteed mileage basis, the following statement may be of interest. One large logging concern on the Pacific Coast is at present purchasing their logging cable on a guaranteed mileage basis and representatives of certain foreign firms are at the present time quietly informing certain purchasers of logging cable that after the war they will be prepared to take orders for cable for logging purposes on this basis. Mr. Weber seems to forget that automobile tires purchased on a guaranteed mileage basis run over sandy and rocky grounds and skid around short bends, yet no one questions the purchase of automobile tires on this basis.

Regarding Mr. Weber's fears as to the danger from electric shock it is very encouraging to note that some engineers of unquestionable ability are of the opinion that the danger voiced is entirely negligible under proped operating conditions. Dynamite is very dangerous when improperly handled, yet we do not hear many advocates of the discontinuing of the use of dynamite for blasing purposes.

The whole question may be briefly summed in the statement that every proposed electric logging installation is an individual problem and must be treated as such and that the basis for decision for or against the electric donkey must be the return it can earn on the money invested.

W. D. PEASLEE.

ALKALI ACTION ON POLE LINE CONSTRUCTION.

A remarkable example of alkali action is shown in a recent issue of the Reclamation Record.

The photograph here reproduced was taken on the Uncompahgre Valley project. The "brooming" of the telephone pole just above the ground surface illustrates in a rather unique manner the expansive action of alkali salts. The project manager states that the water surface at this location is at or very near the ground level throughout the entire irrigation season, and a heavy coating of alkali is visible in the photograph. The pole is of western cedar, and has been in use about 15 years, according to the statement of the Colorado Telephone Co.

The Brooming of a Pole Due to Alkali

It is interesting to note that all the fence posts shown are similarly affected, except the third from the foreground. This post is a peeled cottonwood, while all the others are native cedar. An examination by our engineers of the fence posts in the vicinity brought out the fact that cedar is more susceptible to alkali action than either pinion or cottonwood. The explanation is undoubtedly to be found in the relative porosity of the woods. It is evident that in the treatment of poles or timbers of porous wood exposed alternately to saturation and crystallization of alkali salts a waterproof coating is necessary. Impregnation to prevent decay would be effective only to the extent to which the pores remained permanently filled with preservative.

RECENT STEPS TO OVERCOME ELECTROLYSIS.

The electrolysis survey of the city of Omaha, Neb., by the United States Bureau of Standards was completed a few weeks ago and a report is being prepared to show the measures that must be taken to remove the difficulty. The bureau acknowledges valuable co-operation on the part of the various utilities involved in this work, which promises to have especially important results.

The engineers of the Bureau of Standards are also examining the installation at Springfield, Mass., to see how nearly the results agree with predictions made from the design of their system. If everything is satisfactory, the same system will be installed throughout a large part of the city of Springfield.

OIL FUEL A NECESSITY.

According to the Secretary of the Navy oil fuel is a necessity for the efficient operation of the modern man-of-war. All serious minded citizens should give the matter serious consideration. Editorial comment is made elsewhere in this issue upon this matter. The following are some of the points urged by the Secretary of the Navy to back up his assertions:

When the three-year program already authorized by Congress is completed the navy will require 6,721,000 barrels of fuel oil annually during peace and about three times that amount in the event of war. All new ships are oil burners, and the securing of an adequate supply of oil for the future is a matter of prime importance to the navy. The superiority of oil-burning ships is so great that the Navy Department desired to build oil-burning battleships, but felt that a deterrent, affecting use of oil fuel, was the fear of a failure of the supply.

In 1913 the cost of fuel oil was so great and the number of bidders on the navy's oil requirements so few that in March of that year, before definitely entering upon the policy of constructing only oil burners, the Navy Department wrote to the Department of the Interior asking for information regarding the probable fuel-oil situation twenty years hence and the probbility of being able to secure an adequate supply for the prospective oil-burning fleet. The Department of the Interior replied: "Relief to the navy from increasing commercial prices can probably be secured only by development of its own reserves. * * * It is believed that the Department of the Navy may rely upon the reserves already existing for a supply of fuel-oil for a period greater than the life of any battleship to be constructed within the next decade."

RECORD BREAKER FOR PETROLEUM.

That 1916 was a record-breaking year for the petroleum industry of the United States is indicated in a preliminary estimate of the output of crude oil made by John D. Northrup, of the United States Geological Survey, Department of the Interior.

Mr. Northrop estimates that during the year just closed 292,300,000 barrels of crude petroleum were produced and marketed in the old fields of this country. This quantity is greater by 11,000,000 barrels, or 4 per cent, than the output in 1915. In addition to the quantity of oil produced and maketed in 1916, several million barrels were produced and placed in temporary field storage in Kansas and Oklahoma.

The following table shows by states the marketed production of petroleum in 1915 and an estimate of the production in 1916, in barrels of 42 gallons each:

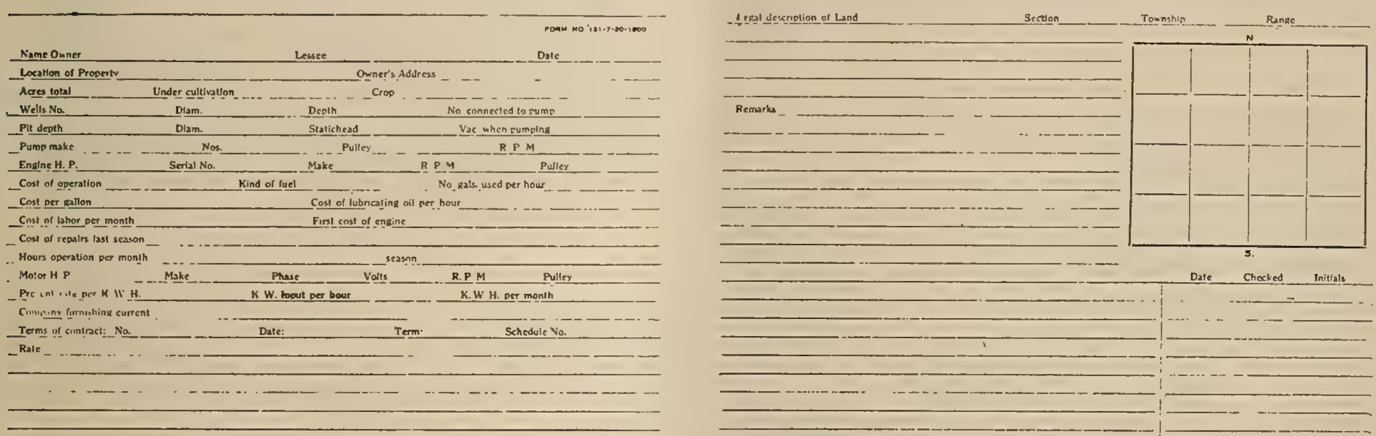
State.	1915.	1916.
Oklahoma	97,915,243	105,000,000
California	86,591,535	89,000,000
Texas	17,467,598	26,000,000
Illinois	19,041,695	16,500,000
Louisiana	18,191,539	15,800,000
West Virginia	9,264,798	8,500,000
Pennsylvania	7,838,705	8,000,000
Ohio	7,825,326	7,400,000
Kansas	2,823,487	6,500,000
Wyoming-Montana	4,245,525	6,300,000
Kentucky	437,274	1,200,000
Indiana	875,758	1,000,000
New York	887,778	900,000
Colorado	208,475	190,000
Other States	14,265	10,000
	281,104,104	292,300,000

MERCHANDISING ELECTRICAL ENERGY

BY ROSS B. MATEER.

(The efficient merchandising of electrical energy is the great problem of Western hydroelectric companies. The constant creating of new uses and new outlets for electric service is welcomed on all sides. Here are some ideas that have been worked out to great advantage at Riverside, Cal., where the author is commercial engineer for the Southern Sierras Power Company.—The Editor.)

Many quasi public utilities report rapidly increasing sales of energy in markets heretofore supplied with service and now yielding as it were a return on the capital expended in efficient sales effort and indexing. Such gain it seems should be abundant proof to the executives of every central station that the systematic expenditure of funds on complete canvasses of present and prospective consumers, on the maintenance of up-to-date card records of appliances and current consuming apparatus in service, and the intelligent following up and closing of possibilities gleaned by an analysis of the indices is more than justified even though frowned upon a few years ago by many apparently intelligent and capable business men.


FORM NO 131-7-20-1800

Name Owner Lessee Date
Location of Property Owner's Address
Acres total Under cultivation Crop
Wells No. Diam. Depth No connected to pump
Pit depth Diam. Statichead Vac when pumping
Pump make Nos. Pulley R P M
Engine H. P. Serial No. Make R P M Pulley
Cost of operation Kind of fuel No gals. used per hour
Cost per gallon Cost of lubricating oil per hour
Cost of labor per month First cost of engine
Cost of repairs last season
Hours operation per month season
Motor H P Make Phase Volts R. P M Pulley
Present rate per K W H. K W. input per hour K. W H. per month
Company furnishing current
Terms of contract: No. Date: Term: Schedule No.
Rate

Legal description of Land Section Township Range
N
S.
Remarks
Date Checked Initials

Front and Reverse for Index and Data

Large sums were usually provided for development work, the locating of power sites, the construction of large reservoirs, the installation of generating machinery and the building of expensive transmission lines but when funds were requested with which to market the energy harnessed and as it were brought to your door by engineering skill a cry is heard from executive officers, unfamiliar with the sale of current and who frequently hold the view that "juice" like groceries is sought by the prospective customer and that convenience of electric light or power will commend it over all other illuminants or fuels irrespective of the expense for equipment or the cost per kilowatt hour.

Merchandising methods of the dark ages are not in vogue today. Salesmen are not sent out to take orders from shop-keepers merely to have their goods on the shelves but wide-awake, aggressive, intelligent high salaried engineers are placed in the field to dispose of and market the stock of the merchant and to create such a demand for certain commodities that the local distributor must file ever repeating and increasing orders with the manufacturer. So electricity must be marketed by creating a demand for such current consuming apparatus as will increase the efficiency of the pumping plant and save a few steps in the home.

Canvas cards may vary in detail to the purpose for which they are desired but the general characteristics remain the same and when used in conjunction with a chart indicating the geographical location of the plant, distribution systems now installed, the acreage susceptible to and at present under cultivation, become of inestimable value not only to the aggressive sales agent but to the progressive commercial manager, by portraying the territory served and the growth in connected load.

At Riverside, California, The Southern Sierras Power Company has built along one wall of the general agent's office a large map consisting of thirty removable panels, each 15½ by 15½ inches and representing a certain township and range, over which the transmission line and the distribution system of that utility has been built. On each panel is traced the principal property lines as recorded in the assessor's office, the natural water courses, gravity ditches and some county roads. On each tract of land is indicated (1) the name of the owner of record, (2) wells drilled but without equipment, (3) wells pumped with fuel or oil engines, (4) wells pumped with electric service, (5) the out door substation, transforming the voltage from 33,000 to 2200 or 440, (6) prospective business requiring immediate attention, and (7) industrial power installations. By the use of color headed tacks one can almost at a glance note the ratio of possible or probable business to that actually connected to the lines.

The legend follows:

Well location		White headed	Tack	○
Drilled Well	○	Bisected White	Tack	⊖
Engine Equipment	⊖	Black headed	Tack	●
Comp. Elec. Equip.		Pink "	Tack	○
Contracted	●	Grey & Black "	Tack	⊖
Active prospect		Red headed	Tack	●

A further examination of the consumers record card will show references to the acres owned by the portion actually irrigated by the pumping plant. By adopting a legend, yellow for fertile soil and green for cultivated acreage the chart becomes more attractive and at all times tells the story not only of a utilities aggressiveness, but of man's conflict with nature and his victory.

Data as to acreage permits of further analysis and the determination of such interesting data as the cost per season per acre irrigated, the acres cultivated per horsepower connected and, the cost per horsepower per season. Unit costs may arm the salesman and assure a contract as much as a timely glimpse of an efficient index permits of a campaign on seasonal appliances. Do you maintain a get-at-able intelligent record of your consumers and their wants electrically? Why not?

Giving your customer his money's worth, is the policy of The Southern Sierras Power Company of Riverside, California, and to this end all monthly accounts of residential consumers have been carefully scrutinized with reference to the kilowatt hour consumption. The results of the investigation were somewhat surprising when it was noted that fifty-four per cent of its patrons used each month only two-thirds of the kilowatt hours due them under the regular minimum charge.

Accordingly the next regular statement carried a small "teaser" reading somewhat like this:

> Additional Service Without Expense
>
> We note that during last month you did not use all of the energy to which you were entitled under your minimum charge. You might have used more lights, larger lamps, an iron or other convenient appliance, without additional expense.
>
> We like out customers to receive a full measure of service for a given sum and hope you will plan to utilize an additional quantity this month, let us help you improve your service.
>
> THE SOUTHERN SIERRAS POWER COMPANY.

Results were apparant immediately. Residences were illuminated to a later hour. Some current consuming appliances were marketed, and less than fifteen per cent of the consumer's meters recorded a consumption below the minimum when next read. This percentage is slowly decreasing while the number of satisfied customers is rapidly increasing. A little judicious advertising pays a good interest on the investment.

The manufacture of nitrogen products from the air heralded as a possible utilization of Western water powers, will need an abundance of natural lime deposits. The Pacific Coast States, including Idaho, produced 95,000 short tons of lime in 1916, or 3 per cent more than in 1915.

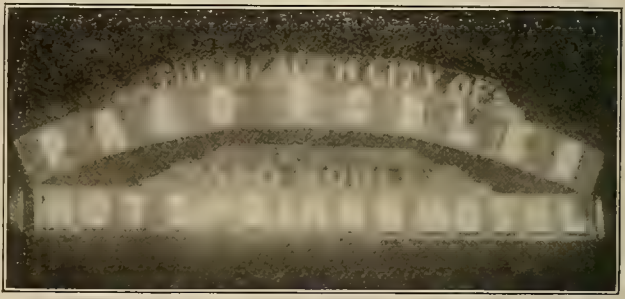
THE ELECTRIC SIGN AS A LOAD BUILDER.

BY T. W. SIMPSON.

One hundred kilowatts of electric sign load is normal for each 50,000 population in cities and towns, but is far exceeded by some Western power companies who take pains to cultivate this load.

One hundred kilowatts does not indicate very much when compared with similar figures of motor load, but interpreted into income at lighting rates and steady four hour nightly burning it means $8750 per year or 17½ cents per year per capita of population without a dollar of secondary line or meter investment.

Surely, this is a load worth having. But this direct gain is not all. The indirect advantage comes about in this fashion. A puts in an electric sign. His neighbors B and C may not have electric signs, but A, B and C will all keep their store windows illuminated several hours later than was the custom before A had a sign. This fact has been proved many times. The indirect gain from a liberal use of electric signs is fully as great as the direct.



A Recent Creation in California showing Across-the-Street Booster Display Sold on Subscription Plan with Central Station Co-operation

A Dignified Sign for Church Display

Years ago the electric sign was looked upon as a splendid load builder. Of late years, owing to the interest attending the introduction of other energy consuming devices, its inherent value has been overlooked. It is as good today as it ever was. And it is just as true now as ever that it will not grow by itself and that it requires co-operation on definite lines between power company and sign manufacturer before it can be obtained.

ELECTRIC POWER FOR IRRIGATION PUMPING

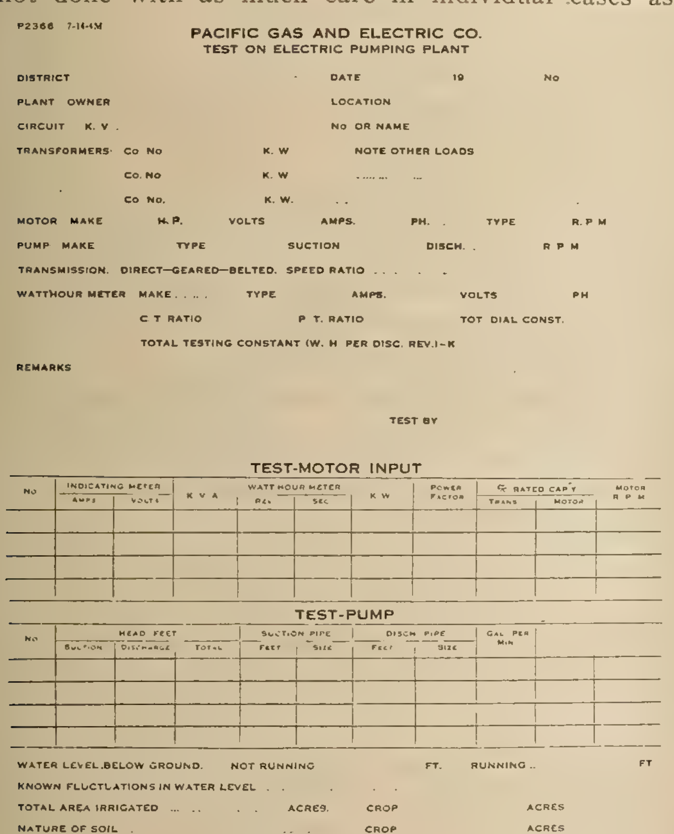
(The efficiency of electrically operated pumping plants is a factor of great importance in recent development of this phase in central station load. Here are data collected by a technical specialist of the Pacific Gas & Electric Company that should prove of unusual value to all Western power companies as definite information from tests is set forth covering many fine points not hitherto positively established.—The Editor.)

TESTS OF IRRIGATION PUMPING PLANTS.

BY F. C. PIATT.

In connection with investigations of the character of the irrigation pumping load of the Pacific Gas & Electric Company in the San Jose and Solano districts made in 1914, efficiency tests were made on about 350 small pumping plants. About 90 per cent of these plants consisted of small centrifugal pumps either direct or belt connected to electric motors.

The purpose of this work was to secure data on the general results being obtained. The testing was not done with as much care in individual cases as



P2366 7-14-4M

PACIFIC GAS AND ELECTRIC CO.
TEST ON ELECTRIC PUMPING PLANT

DISTRICT DATE 19 No
PLANT OWNER LOCATION
CIRCUIT K. V. No OR NAME
TRANSFORMERS Co No K. W NOTE OTHER LOADS
Co. No K. W
Co No. K. W.
MOTOR MAKE H. P. VOLTS AMPS. PH. TYPE R. P. M
PUMP MAKE TYPE SUCTION DISCH. R P M
TRANSMISSION. DIRECT—GEARED—BELTED. SPEED RATIO
WATTHOUR METER MAKE TYPE AMPS. VOLTS PH
C T RATIO P T. RATIO TOT DIAL CONST.
TOTAL TESTING CONSTANT (W. H PER DISC. REV.)—K
REMARKS

TEST BY

TEST-MOTOR INPUT

No	Indicating Meter Amps	Indicating Meter Volts	K V A	Watt Hour Meter Rev.	Watt Hour Meter Sec	K W	Power Factor	% Rated Cap'y Trans	% Rated Cap'y Motor	Motor R P M

TEST-PUMP

No	Head Feet Suction	Head Feet Discharge	Head Feet Total	Suction Pipe Feet	Suction Pipe Size	Disch Pipe Feet	Disch Pipe Size	Gal per Min

WATER LEVEL BELOW GROUND. NOT RUNNING FT. RUNNING FT
KNOWN FLUCTUATIONS IN WATER LEVEL
TOTAL AREA IRRIGATED ACRES. CROP ACRES
NATURE OF SOIL CROP ACRES

Front and Reverse of Form for Test Data.

would have been used if recommendations regarding the plants were to have been made to the owners. Care was taken, however, not to introduce any systematic errors so that the mean results secured should be relatively accurate. The form used for recording the data is shown in the illustration. Statistics regarding the use of the water were collected for application in load diversity and other studies.

Volts and amperes were read by portable instruments. The kilowatt load at each plant was obtained by counting the revolutions of the regular watt-hour meter disc, no special test meter being carried. As the meters were in good condition, it is considered that the kilowatts input was obtained quite closely. Revolution counters were used to obtain the speed of pumps and motors.

Measurements of the water discharged were made in various ways. In some cases weirs or tanks were already in place and could be used. Where the discharge was into open ditches, the surface velocity was obtained by floats in straight ditch sections and the discharge obtained by using a coefficient to reduce the surface velocity to the mean. In many cases, where the water was discharged into the air from the horizontal pipes, measurements of the path of the jet were used to compute the quantity. Comparison of these latter methods with more exact methods, where they could be used, indicated that the results were usually within about 10 per cent of the correct.

Measurements of the lift were made directly from the water surface elevations. In some plants it was difficult to secure the exact amount of suction lift as a sounder could not be used between the well casing and the suction. In such cases the suction was estimated.

The efficiency was computed by comparing the theoretical power required to raise the discharge through the actual measured head with the actual measured power delivered to the motor. This expresses the relation between the power which is being paid for and the results accomplished by its use. The efficiency secured is for the plant overall and includes losses in the motor, in the transmission to the pump, in the inlet and outlet pipes of the pump and in the pump itself. The actual efficiency of the pumps will be higher than these overall efficiencies, the amount of the difference depending on the character of the transmission of power from the motor to the pump.

The general results are given in Table I. In the San Jose district the vertical centrifugal pump belt connected to the motor is the prevailing type. In the Solano district the depth to ground water is less and direct connected pumps are more usual. A few deep well turbines and plunger pumps are also used. The results are segregated by types and sizes for the centrifugal pumps. The number of tests on which each mean is based is also given. The efficiencies do not vary consistently with the size in all cases. This is due in part at least, to the wide differences found in individual plants and the smaller number of tests forming some of the means.

In Table I, the mean of the one-fifth of the plants in each classification which gave the lowest overall efficiencies is given for the sizes for which sufficient tests are available. These minimum results indicate the low efficiencies which are being obtained in some cases, due to different unfavorable conditions. Such

conditions are more probably those of poor judgment in the selection or poor care in operation, rather than any inherent fault mechanically of the equipment itself. In the same way the mean of the maximum 20 per cent of the results is given. These show the results which may be obtained with properly selected and maintained plants.

A comparison of the efficiencies for direct and for belt connected pumps, as given in Table I shows no consistent difference. For similar conditions the direct connected pump should give somewhat higher efficiency due to the saving of the belt loss. Where the water level and height of lift fluctuates, direct connection which does not permit variations in speed, may be less efficient as the efficiency of the pump at the given speed varies with the lift. The average lift for the vertical belted pumps is higher than that for the direct connected plants so that they can not be directly compared. The lifts for the direct connected and for the horizontal belt connected pumps are similar although the number of tests of the latter type is relatively small. Taking the difference in mean efficiency for the various sizes weighed by the number of tests, gives an average efficiency of about 5 per cent higher for the direct connected pumps than for the horizontal belt connected pumps.

If the belt connected vertical pumps having lifts similar to those of the direct connected ones are similarly weighted, the average efficiency of the direct connected plants is about 3.5 per cent higher.

The average speed of the direct connected pumps is much higher than for belt connection for the same size and lift. This is necessary as the motors have relatively high speeds. When the pumps are designed for such speeds, good results are obtained as long as the conditions do not vary materially. With belt connections the pulleys can be changed to give speeds suited to the variations in lift that may occur during any season or from year to year. The lack of adjustment of the speed to the lift with direct connected pumps may cause a greater loss of efficiency than the loss in belt connection. The rated efficiency of motors varies with the size. Belt losses should not exceed 6 per cent; for worn or loose belts this loss may be exceeded.

The following figures give the usual efficiencies of motors and for motors and belts, the belt loss being taken as 6 per cent of the power delivered by the motor.

Size Motor horsepower.	Efficiency of Motor.	Efficiency of Motor and Belt.
Less 15	86	81
15- 50	88	83
50- 75	89	84
75-100	90	84.5
Over 100	91.5	86

These figures are used to estimate the pump efficiencies given in the last column of Table I. For direct connected plants only the motor loss is deducted, giving the efficiency of the pump and and piping. For belt connected plants the combined motor and belt loss is deducted. For horizontal pumps this gives the efficiency of the pump and piping; for vertical pumps the losses in the shafting are charged against the pump. Estimates made for a number of the plants gave an average friction loss in the piping of about 5 per cent of the power input.

The variation of the efficiency with the size is not as marked as usually found. For sizes of 3½ in. or less, the efficiency is consistently lower. For sizes of 4 in. or over, the variations are smaller and less regular. The number of tests on pumps larger than 6 in. is, however, small. In Table 2, all types of centrifugal pumps are grouped. These show an increase up to the 4 in. sizes. From 4 to 8 in. the variations are small and irregular.

The efficiency of a small pumping plant depends upon so many factors that it is difficult to segregate the effect of any single factor. In Table 3, the sizes for which the largest number of tests are available are segregated by the height of lift. The average for all single stage pumps from 3 to 8 in. in size, and also the average including the two or three-stage pumps, are given. The lower efficiency for lifts less than 20 ft. is quite marked. For lifts over 30 to 40 ft., the difference is not as marked, although there is a small but irregular tendency to increase the efficiency at the higher lifts. This is to be expected as the efficiency of the larger motors will be somewhat higher than for the small ones used on the lower lifts, and the mechanical losses in the pump are a greater proportion of the total input where the lift is small. With equal hydraulic efficiencies on all lifts these factors would give lower efficiencies on the low heads.

In these investigations it was found that the low efficiency of some plants might be due to any one of a number of factors. The most important of these were:

(1) Friction losses in suction and delivery pipes.
(2) Discharge of an excessive quantity of sand.
(3) Poor lubrication.
(4) Loose belts.
(5) Losses in long shafts, generally used in the San Jose territory, due to bearing friction and poor alignment.
(6) Leakage of air through loose stuffing boxes.
(7) Running at speeds not suited to the pump.
(8) Underloaded motors.

The average results for all plants may be of interest as indicating the general conditions in a given territory or with a given class of plant. Where the individual plants vary in so many factors average results are little indication of what will be accomplished in any particular case. The overall efficiency of the 357 plants tested was 35.5 per cent. The average lift was 52 ft., and the discharge 600 gallons per minute. This is equal to 1.33 second feet, or 67 in. as used in Southern California. The probable average efficiency of the pumps alone was about 42.5 per cent. The average overall efficiency is equivalent to the use of 2.9 kilowatt hours for each acre foot of water lifted one foot and also to 5.8 miners' inches lifted 100 ft. for each kilowatt of input. The average input per plant was 15 kilowatts.

For the 104 direct connected centrifugal plants tested, the average overall efficiency was 35 per cent, the average lift 33 ft., and the average discharge 630 gallons per minute. These represent quite closely average conditions in the Solano district as this is the prevailing type of plant in that locality. The average input was 11 kilowatts.

For the 140 vertical belt connected plants tested, the average overall efficiency was 37 per cent, the lift

Table 1. Summary of Results of Tests of Irrigation Pumping Plants.

Kind of Pump.	Size of Pump.	Number of Tests.	Mean Discharge—gal. per minute.	Mean Suction Lift, ft.	Mean Total Lift, ft.	Revolutions per min. of Pump.	Mean Kilowatts Input.	Overall Efficiency. Mean of al Tests.	Overall Efficiency. Mean of Lowest 1/5 of Results.	Overall Efficiency. Mean of Highest 1/5 of Results.	Estimated Efficiency of Pump. Mean of all Tests.
Horizontal direct-connected centrifugal pumps.....	2½	2	175	12	31	1750	4.3	24.6	....	....	29
	3	5	170	15	45	1740	5.2	25.7	....	....	30
	3½	2	260	17	25	1470	5.4	38.4	....	....	45
	4	25	410	13	35	1440	7.8	35.5	17.6	57.0	41
	5	16	470	15	34	1200	9.3	31.1	16.7	42.0	36
	6	23	675	13	32	1250	11.6	36.4	13.0	56.2	42
	7	19	880	14	30	1120	13.2	36.4	21.1	55.8	42
	8	12	1125	16	32	1050	18.6	40.0	18.6	64.6	46
Horizonal belt-connected centrifugal pumps........	2	7	115	14	25	1225	2.3	26.0	....	....	32
	2½	4	172	13	21	1315	3.4	23.0	....	....	28
	3	13	337	9	22	940	5.9	21.6	9.5	36.4	27
	3½	1	310	11	23	1140	...	10.3	....	....	13
	4	8	375	6	26	800	6.7	25.5	....	....	32
	5	5	410	14	35	780	7.3	38.0	....	....	47
	6	5	560	12	27	760	9.7	24.8	....	....	31
	7	7	690	10	30	650	11.8	32.2	....	....	40
	8	1	1040	..	8	707	19.4	8.6	....	....	10
	10	1	1650	24	28	570	30.5	29.8	....	....	36
	12	2	1980	9	13	440	27.0	27.0	....	....	32
Vertical belt-connected centrifugal pumps..........	2½	1	150	23	49	1540	5.1	27.0	....	....	33
	3	12	315	16	53	1250	10.9	28.2	16.2	43.6	35
	3½	2	375	8	38	915	7.6	35.4	....	....	43
	4	41	495	15	62	975	15.1	38.1	17.4	56.8	47
	5	60	730	16	57	870	20.2	39.6	21.5	58.4	48
	6	20	935	16	46	825	23.0	36.2	20.0	49.2	44
	7	4	1015	19	43	840	22.2	37.4	35.0	39.7	45
Vertical belt-connected two-stage centrifugal pumps	1½	1	100	2	27	2000	2.8	18.2	....	....	23
	3	1	300	12	80	1150	11.6	39.0	....	....	48
	4	9	460	17	110	1025	24.3	40.2	21.4	56.8	48
	5	10	650	17	94	1000	34.9	38.5	20.9	53.0	46
	6	1	625	0	103	625	33.0	36.7	....	....	44
Three-stage centrifugal pumps.....................	3	1	300	4	119	1020	17.0	39.4	....	....	48
	4	1	450	0	112	1030	30.0	31.6	....	....	38
Well turbines	..	23	750	6	87	930	27.0	40.8	24.7	61.7	49
Plunger pumps	..	12	60	..	133	...	4.1	46.1	27.8	63.2	57

Table 2. Mean Overall Efficiency of all Types of Centrifugal Pumps.

Size of Pump.	Number of Tests.	Mean Discharge, Gallons per min.	Mean Suction Lift feet.	Mean Total Lift feet.	Mean Revolutions per min. of Pump.	Mean Kilowatt Input	Mean Overall Efficiency.
2	7	115	14	25	1225	2.3	26.0
2½	7	170	14	28	1475	3.9	24.0
3	32	300	12	36	1190	5.1	25.8
3½	5	317	12	37	1180	6.0	31.6
4	84	453	14	56	1100	13.2	36.3
5	91	659	16	56	937	19.2	37.9
6	49	770	14	39	1020	16.5	35.6
7	30	854	14	32	970	14.1	35.6
8	13	1117	15	30	1023	18.6	37.5

56 ft., and the discharge 650 gallons per minute. These are smaller average sizes and lifts than for the other types of plants and the resulting efficiencies are consequently lower.

For the vertical belt connected plants tested, the average overall efficiency was 37 per cent, the lift 56 ft., and the discharge 650 gallons per minute. These results are representative of average conditions in the Santa Clara valley, where this kind of plant is the prevailing type.

The mean results for the deep well turbines are given in Table I. The average efficiency of the well turbines is somewhat higher than that for all the centrifugal pumps of either type. However, the average capacity and lift of the well turbines is greater. When compared with two-stage centrifugal pumps having similar lifts, but smaller discharge, the difference in efficiency is less. The number of tests of well turbines is not as large as for the direct connected and vertical belted centrifugal plants. If the well turbines are compared with the 5 in. vertical belted centrifugal pumps having an average lift of 57 ft., a difference in efficiency of about 1 per cent in favor of the well turbines is shown. The 23 tests indicated that higher efficiencies would be obtained at the lifts of over 100 ft. and for discharges over 800 gal. per min. The numbers of tests are not sufficient to warrant giving numerical values for such differences.

The average for the 12 tests of plunger pumps is also given in Table I. These gave the highest average efficiency of any of the types of plants tested. The discharge was smaller than for other types and the lift greater. The multiple stage centrifugal pumps have the most similar conditions of lift. For all sizes the average efficiency of the multiple centrifugal pumps is lower than the mean for the plunger pumps. The efficiency of the different plants varied quite

Table 3. Variation of Overall Efficiency of all Types of Centrifugal Pumps with the Total Lift.

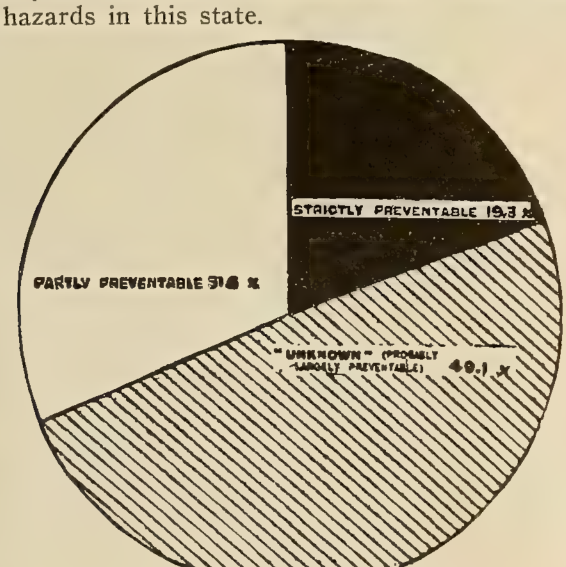
Total Lift in Feet	—4-inch Pumps.— No. of Tests.	Mean Overall Efficiency.	—5-inch Pumps— No. of Tests.	Mean Overall Efficiency.	—6-inch Pumps.— No. of Tests.	Mean Overall Efficiency.	All Sizes of Single Stages. No. of Tests.	Mean Overall Efficiency.	All Sizes, including Multiple Stages. No. of Tests.	Mean Overall Efficiency.
Less than 20......	3	12.6	3	12.2	5	10.2	24	15.5	24	15.9
20 to 30......	12	24.8	10	30.4	3	30.9	34	27.8	34	27.8
30 to 40......	11	36.8	11	35.6	17	40.2	54	38.7	55	38.2
40 to 50......	14	43.4	11	38.0	10	39.4	50	39.3	50	39.3
50 to 60......	9	39.4	16	43.5	5	39.1	31	41.7	33	41.0
60 to 80......	6	46.9	17	41.6	..	....	27	41.8	30	41.2
Over 80......	11	42.6	8	39.5	..	....	21	41.4	34	42.2

widely, due to such factors as too high piston speed, and excess slip.

It is thought that the number of tests included in the data presented is sufficient so that the figures given are representative of the results actually being obtained in the field use of such plants. The overall efficiencies given are those on which the power costs are based. The wide differences for all types between the average minimum and maximum results indicate that many plants have not been properly selected or maintained. The plants include a number of different makes of pumps. A segregation by makes of pumps showed no consistent differences in the efficiency of different makes. A study of the general results seems to indicate that in many cases the actual efficiency which the pump is capable of obtaining may not be the most important factor in the plant as a whole. If the conditions of use do not correspond to the conditions for which the pump was designed, low efficiency will result, as even a well-built pump can not overcome unfavorable conditions of use. The proper adjustment of speed to lift, proper maintenance of bearings and shaft alignment, and care of the belt are essential to good results. The neglecting of these factors can not be charged directly against the pumps. Where one-fifth of the owners obtain results varying from two to three times better than the poorest one-fifth for the different types of pumps, it is evident that improvement should be possible in at least one-half of the installations.

PERCENTAGE OF PREVENTABLE FIRES IN OREGON.

More than half the fires in Oregon during the year 1915 were either strictly preventable or partly preventable said the National Board of Fire Underwriters, which just completed an exhaustive survey of fires and fire hazards in this state.



Graphic Chart for Fires

To be precise, 19.3 per cent of all the fires are classified as "strictly preventable," and 31.6 "partly preventable," an aggregate of the two classes of 50.9 per cent.

The remaining 49.1 per cent are attributed to "unknown" causes, with the comment "probably largely preventable."

OVER IRRIGATION.

In a recent paper on fundamental principles of modern irrigation practice, Professor Powers of the Oregon Experiment Station calls attention to the possible dangers of over irrigation, in which he says that over irrigation is probably the greatest menace to irrigation agriculture. The danger of over irrigation on sandier soils is that it will leach out the valuable available plant foods, while on the heavy soils, it results in water logging and accumulation of alkali. Water logging causes rotting off of plant roots where they have developed in the deeper soil strata or prevents deep rooting if the roots have not already formed. A shallow rooting plant is not resistant to drought, whereas the main thing to develop in any arid plant is a deep rooting system that is drought resistant. With over irrigation the crop yields are lower for each unit of water used. More plant food is taken up by the plants for each pound of dry matter produced. The quality of the crops is greatly reduced and there is a higher proportion of plants in proportion to fruit or grain produced. Extension of the irrigated area is also hindered and other dry land is cheated of its irrigation water. A permanent system of irrigation agriculture depends on the economical use of irrigation water. If we can save 50 per cent of the water now used, it will mean that we can practically double the irrigable area in the west.

PROPOSED ROADS IN OREGON COMPARED WITH THOSE IN CALIFORNIA AND WASHINGTON.

In the recent commonwealth conference held at Portland, Oregon, John H. Lewis, state engineer thus summarized the roads and total distribution of mileage as follows:

It will require approximately 4200 miles of state roads to connect each county seat and adequately serve all parts of the State.

As feeders to this trunk line system, approximately 8000 miles of high class county roads will be necessary.

We thus have a total of 12,200 miles of state and county roads to be built and maintained in accordance with modern standards required by motor vehicle traffic. In addition there are approximately 33,000 miles of local or district roads which must also be maintained.

With our great area, and limited population and taxable wealth, we are thus confronted with an enormous task. Its magnitude will perhaps be appreciated better by comparison with New York State which has practically the same length of state and county roads. Here state bonds to the extent of $100,000,000 have been issued and expended along with liberal allotments by counties and the system is only about seven-tenths complete.

The California state highway system includes 2900 miles or three-fourths that suggested for Oregon. It is estimated that $50,000,000 will be required to complete that system. Washington has 3293 miles designated as state routes.

ELECTRIC COOKING AND HEATING

(The application of electrical energy to the chicken industry in the West has had a most marked beneficial effect. The even temperature that is possible under electrical application is revolutionizing methods in vogue until recently in the great chicken raising districts of the West. Below is set forth an interesting article on this important subject.—The Edtor.)

INCUBATING AND BROODING BY ELECTRICITY

Modern Methods.—Although artificial incubating and brooding has been practiced for many years in Europe, Asia, and the United States, the latter country has been most progressive in developing means for utilizing electric heat as a substitute for heat produced by fuel combustion methods. The superiority of electricity is quite obvious to anybody familiar with the poultry business. The number of fuel heated incubators and hovers in use in this country reaches well into the millions, but the vast field which the application of electric heat to these devices has opened up for the manufacturer of heating apparatus and the distributor of electric energy is little appreciated. In one small town in California about 10,000,000 chicks are hatched annually by artificial means. The hatching and brooding of these chicks would require about 3,000,000 kw-hr. per year, if electric operation was substituted for fuel.

Portion of White Hatchery, Petaluma, Cal.
(Capacity 40,000 eggs)

The character of the load is desirable from the standpoint of the central station. The machines are non-inductive, and the diversity factor is naturally high. Where a large number of machines are in use the load is not one that varies greatly with the season of the year as might be supposed.

The processes of incubating and brooding are outlined in order to convey a clearer appreciation of the advantages afforded by the application of electric heat.

Poultry Incubating.—All kinds of eggs may be hatched by artificial means. The period of incubation varies with the kind of egg and with temperature conditions. If the heat has been maintained at too low a temperature during the period of incubation, or if the eggs have been chilled or overheated, the hatching may be delayed somewhat.

The average incubating periods of various kinds of eggs by both natural and artificial methods are as follows:

	Days.
Hen egg	21
Pheasant egg	23
Guinea egg	27
Duck egg	28
Peafowl egg	28
Turkey egg	28
Goose egg	32
Duck egg (Muscovy)	34
Ostrich egg	42

The hatching of chickens by artificial means is perhaps most commonly known, and is therefore described.

Incubating of Chickens.—The eggs are placed on portable trays at an angle of about 45 degrees, with the small ends down, leaving the air cells in the large ends. These trays are then placed in the incubator, and the temperature brought up gradually to 102° F., and maintained at that point for from four to six days, when a test is made. This test consists in holding the tray of eggs to the light. If they are fertile the operator will observe a spider like shadow within the eggs, showing that they are germinating. The eggs that are not fertile will be perfectly clear, and will be removed from the tray. Another similar test is often made about the fourteenth day. After the first test is made, the temperature is usually brought up to 103° F. and maintained at that point until the hatch is off. The temperature is always taken with

Petaluma 200 Egg Incubator

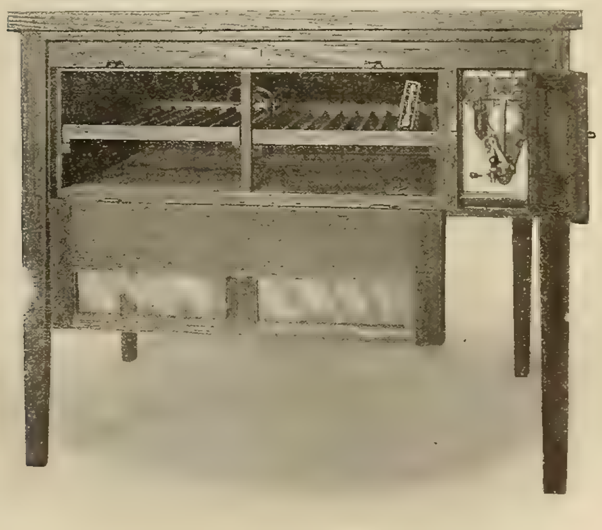
the bulb of the thermometer even with the horizontal plane of the eggs.

After the eggs have been in the machine about seventy-two hours, they are cooled daily by removing the trays from the machine for from one-half hour to two hours, depending upon the temperature of the incubating room. When they have cooled to about the temperature of one's body, (which may be observed by holding one of them against the cheek), they are put back in the machine. The eggs are cooled to allow the germ to rest, for otherwise the chick when hatched would be weak and nervous. Each time the eggs are cooled they are turned at a different angle, but the small end is always kept pointing downward.

Constant observations are made to see that the egg is drying down properly. By the eighteenth day the air cell in the large end should be dried down to about 30 per cent of the total volume of the shell. To hasten the drying process, ventilation may be increased provided no drafts are produced. In case the eggs dry down too rapidly, the bottom of the incubator may be sprinkled, or a slight spray of water given the eggs.

After the eighteenth day the incubator is closed until the chicks are taken off. A slight film of moisture, on the lower edge of the inside glass, usually indicates that the air is of proper humidity for "pipping." As the chicks "pip" through their shells, they drop through the trays to the space below, known as the nursery. After they are about twenty-four hours old, they are removed to the brooders.

Electric Incubators.—These appliances usually consist of square or oblong cases mounted on wooden supports. They may be double walled with shoddy, mineral wool, asbestos, or other heat insulating material interposed, or single walled lined with heavy paper. Tight fitting double doors, the inner one always



Electro-Hatch 200 Egg Incubator

of glass, are provided along the front for examining the interior and moving the egg trays. These trays are made of either wood or metal and are inserted in the machine about four inches from the bottom. The heating elements are usually mounted near the top of the egg chamber, although in some makes of double deck incubators heating elements are placed near the bottom, as well as at the top.

Single deck types are claimed to be more satisfactory than double deck machines, on account of the more uniform heat that may be applied on a single plane. On the other hand, the double deck type requires less energy for heating a given number of eggs. In the single deck types provided with top heating units, the temperature is naturally higher above the eggs, and lower below them. The temperature in the nursery below the trays is therefore maintained at about 95° F., which is considered most desirable for newly hatched chicks.

The thermometers used in incubator work should be high grade instruments, because it is essential to know at all times just what temperatures are being maintained. A slight error in the thermometer will have a large influence on the success of the hatch.

Most of the thermostats that have been developed for use with electric incubators are extremely sensitive and are capable of maintaining the desired temperature to within ¼° F. to ½° F. These devices should be simple in construction, positive in action, and absolutely reliable, in order to insure the best results.

A well constructed single deck machine is generally provided with an average of about 75 watts heating capacity per 100 eggs. The average current consumption has been found to be about 10 kw-hr per hundred chicks hatched. Incubators are now available that will hold from 30 to 1200 eggs.

Advantages of Electric Incubators.—An incubator heated by coal, oil, or gas is constantly filling the machine with fumes and burning up oxygen so essential to the germ life in the egg, whereas electricity neither destroys good air nor gives off bad air. The temperature control is simple and requires no attention, other than setting the thermostat by turning a thumb screw a couple of times during the hatch. The fire risk is entirely eliminated. The anxiety that attends the operation of fuel heated machines is done away with. The distribution of heat is perfect and the ventilation can be regulated at will. Much time and labor usually required in looking after fuel equipment is saved. The machines may be located in any convenient place and are adaptable to any climate. It is furthermore interesting to note that electrically hatched chicks always begin to pip about twelve hours quicker than those hatched by other artificial means. They are always stronger and more vigorous, and statistics show that a much higher percentage is hatched.

Relative Operating Costs.—The following comparative figures are taken from many averages secured in actual practice. They are based on an assumed incubator room temperature of 60° F. Although a rather low rate for electricity is required to make the actual operating cost comparable with those of some of the less expensive fuels, the savings effected, the better results secured, and the greater degree of satisfaction obtained by electric operation, will usually overcome whatever objection arises as to the cost of producing heat.

Relative Cost of Heat for Incubating.

Method of Heating.	Approximate Cost. Per 100 Eggs.
600 B.t.u. gas at $1.50 per 1000 cu. ft.	37c
600 B.t.u. gas at $1.00 per 1000 cu. ft.	25c
Coal oil at 20c per gallon	20c
Electricity at 5c per kw.-hr	50c
Electricity at 3c per kw.-hr	30c
Electricity at 2c per kw.-hr	20c

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(Much confusion has existed in the past regarding proper wiring methods for starting three-phase motors. Revised nomenclature for oil switches is still a matter of uncertainty with the contractor and dealer, while the subject of handling noise in ceiling fan motors is largely an unknown quantity. These items are all discussed in this department by the power apparatus specialist of the Western Electric Company at San Francisco, and should prove of timely use for the contractor and dealer.—The Editor.)

STAR-DELTA METHOD OF STARTING THREE PHASE MOTORS.

This method of starting is used to some extent with squirrel-cage motors which have their stator windings so arranged that they may be connected in star, or Y, for starting and delta for running. Separate stator windings are not required, but both ends of each phase must be brought out through the stator frame and a suitable switch must be provided to effect the change in connections. There are several special switches on the market for this purpose. It is also possible to use standard knife switches. Further details of these switches and their connections will be given later in this article.

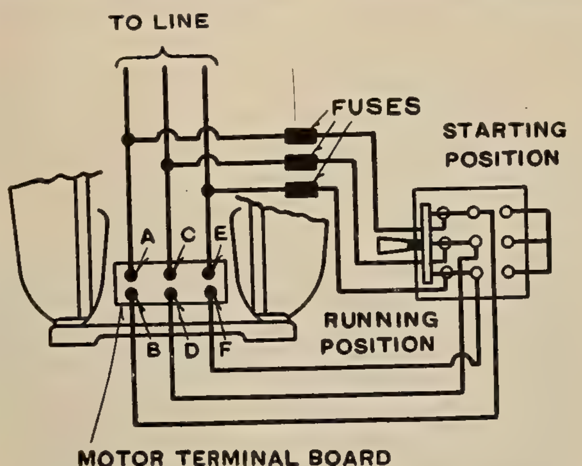
In starting, the switch is thrown into the starting position which connects the windings of the motor in star. When the motor has come partially up to speed, the switch is then quickly thrown to the running position which connects the windings in delta. The effect of connecting the windings in star during starting is to reduce the voltage applied to each phase winding to 57.7 per cent of full line voltage, while in the running position full line voltage is impressed across each phase of the winding. The starting torque and current will each be one-third the value obtained with the windings in delta.

Let us now apply these facts to an actual case. Take, for example, a certain 7½ h.p. 1200 rev. per min., 220-volt, 3-phase, 60-cycle, squirrel-cage induction motor. The full load running current is 19 amperes per phase. When this motor was started by being thrown directly across the line at full voltage the starting current at the instant of closing the switch was found to be 600 per cent of the full load current or $6 \times 19 = 114$ amperes, while the starting torque developed was equal to 180 per cent of full load torque.

Now suppose this same motor is started by the star-delta method. At starting, the voltage across each phase is 57.7 per cent of $220 = 127$ volts. The starting current will be 1/3 of $114 = 38$ amperes and the starting torque 1/3 of $180 = 60$ per cent of full load torque. If this torque is not sufficient to accelerate the motor, it will be necessary to either reduce the load on the motor or start it by some other method which will give higher voltage at starting and thereby develop a higher starting torque.

The starting torque of an induction motor varies quite widely, depending upon the size, speed, frequency and especially on the resistance of the rotor. For a squirrel-cage motor of the ordinary design, the starting torque will vary from about 100 to 200 per cent of full load torque when started at full line voltage while the line current will be from 5 to 7 times full load running current, which corresponds to about 3½ to 4½ times full load current for a starting torque equal to full load torque.

Here it is well to note that the starting current taken by a squirrel-cage motor at the instant of starting depends upon the voltage applied to its terminals. The duration of this current only, but not its value, is dependent upon the torque required to start the load. The current is maximum at the instant of starting but falls quickly to the value corresponding to the torque required by the load and then decreases gradually as the motor runs up to speed. Briefly this means that



Star-Delta Method Using Ordinary Knife Switch

the starting current of a motor is the same for a given voltage whether the motor is started without any load or against a heavy load. However, when starting against load the motor will come up to speed more slowly and therefore the heavy starting current will be maintained for a greater period of time.

The following tabulation gives the approximate starting torque and starting current, for a line of 60 cycle motors, obtained when starting the motors at full line voltage and when using the star-delta method. Both torque and current are expressed in per cent of full-load operating values:

No. of Poles in Motor.	Synchronous Speed.	Thrown Directly Across Line at Full Voltage. Torque.	Current.	Star-delta Method. Torque.	Current.
2	3600	180	490	60	163
4	1800	180	490	60	163
6	1200	175	485	58	161
8	900	165	480	55	160
10	720	150	430	50	143
12	600	140	400	47	133

From these figures it will be apparent that the starting torque under the star-delta method is insufficient except for easy starting service, especially in the slow speed machines.

In fact, this is one of the principal objections to this method of starting. These figures show what could be expected from an ordinary line of motors. However, the best results are obtained by designing motors especially for this method of starting. By doing so it is possible to increase the starting torque somewhat above the values here given.

A further disadvantage is that the starting torque in a given motor is fixed, whereas, when using a starting compensator it is possible to adjust the torque to suit the conditions.

From the manufacturing and designer's standpoint there are several important disadvantages. While these may not be of particular interest to many of our readers they will explain, partly, why motors wound for this method of starting are not more in general use. Perhaps the most important is that since motors of the same rating are built for several different voltages and many different ratings are built in the same frames with the number of stator slots unchanged, it is necessary that the connections of the stator coils should not always be limited to delta for normal running conditions.

The accompanying diagram shows the connections most commonly employed for this method of starting. The necessary change in connections from star to delta is made by a three-pole double-throw switch. This switch may be of the ordinary knife-blade type but it is better to use a switch which is equipped with a spring arrangement to prevent the handle being left in the starting position. By slightly modifying the connections, standard motor starting switches commonly used for small induction motors can be used for this purpose.

The fuses shown are for protecting the motor when running. It will be noted these fuses are not in the circuit when the switch is thrown to the starting position. Note also that a separate switch is necessary to completely disconnect the motor and starting switch from the line. This switch must always be provided, otherwise the installation would not be in accordance with the National Electrical Code.

Another article on this subject showing how the same results may be obtained with a single-knife switch will appear in a later issue. Suitable connection diagrams will be given. Also a new type of switch just placed on the market will be described.

REVISED NOMENCLATURE FOR OIL SWITCHES.

To agree with the definition given in the latest rules of the American Institute of Electrical Engineers, those devices formerly known as "oil switches" or "oil-break switches" are now called "oil circuit breakers." Article 724 in these rules describes a circuit-breaker as "A device designed to open a current-carrying circuit without injury to itself. A circuit-breaker may be (a) an automatic circuit-breaker, which is designed to trip automatically under any predetermined condition of the circuit, such as an underload or overload of current or voltage; (b) a manually tripped circuit-breaker, which is designed to be tripped by hand. Both types of operation may be combined in one and the same device."

Since there are also "air" circuit-breakers in the market, it will be necessary to avoid misunderstanding or confusion of terms, when referring to circuit-breakers, to state whether "oil" or "air" circuit-breakers are meant. The term "air" is used to distinguish carbon break and magnetic blowout types of circuit-breakers from oil circuit-breakers.

NOISE IN CEILING FAN MOTORS.

The noise produced by ceiling fans is probably the most common complaint registered against them. This is especially true of alternating current fans. Ordinarily a noisy fan is judged as being defective without any investigation whatever. The usual claim is that the bearings are out of alignment or something of that nature pertaining to them. However, this is now rarely the case. In most instances, the trouble will be found due to the method of installation or some other cause external to the motor itself. It is therefore good practice to carefully examine all parts likely to produce noise before attempting to locate the difficulty by removing the fan and taking it apart. This should always be done with the fan in its original position.

First of all the light metal parts on the hanger, such as the light shells covering the joint in the extension rod, should be examined. These may be sufficiently loose to vibrate or the canopy covering the insulated hanger eye may be loose and vibrate against the hanger. Vibration in the small shells covering the hanger joint can usually be remedied by bending them slightly with the hand until they are tight. If the trouble appears to be in the canopy at the top of the hanger, the set screw in the canopy should be tightened. If this does not remove the vibration it is then well to try wrapping a little friction tape around the hanger rod in such a manner as to prevent the metal parts of the hanger and canopy from touching.

If the noise is still noticeable, it may then be due to the manner or position in which the fan is suspended. Occasionally an alternating current fan is hung upon a ceiling which vibrates with the current, and which to a certain extent acts as a drum head, magnifying the vibration of the current. If this condition exists, it can be determined from the fact that in the room where the fan operates, no disagreeable amount of noise is apparent, but in the room above that in which the fan is hung, the noise will be much more noticeable, and sometimes very disagreeable. Where this condition exists, the trouble is not with the fan but is due to the manner in which the ceiling is constructed.

There does not seem to be a general method of eliminating the noise under these circumstances other than by removing the fan entirely, excepting that some times if the fan is moved to a different part of the ceiling the noise disappears.

Noise may also originate within the motor itself. Here it will generally result from worn bearings which sometimes allow the armature to move out of alignment and strike against the field. This trouble can be easily ascertained by inserting a small piece of paper in the air gap between the armature and field. In this connection it must be remembered that the clearance between the field and armature in a ceiling fan is exceedingly small and only a slight displacement is necessary to make trouble.

PACIFIC COAST N. E. L. A. SECTION JOTTINGS

(The recently established Pacific Coast section of the N. E. L. A. is already proving itself of active service to Western central stations. Herein may be found a current record of novel engineering, commercial and accounting practice among the membership of this organization. Contributions from all member companies are invited.—The Editor.)

St. Catherine's Well—a Corner at the Glenwood Inn.

SOME time during April the Pacific Coast N. E. L. A. Section is to hold its first convention. There are many places in the territory involved where a gathering might with profit be held and doubtless as the years roll on all of the various bidders for the honor of acting as hosts for the occasion will have an opportunity to have their hopes realized. In choosing the place for the initial gathering, however, unusual considerations must be carefully weighed before a final decision can be reached.

An Invitation to Meet at Riverside.

A. B. West, vice-president of the Southern Sierras Power Company has extended an invitation to the Pacific Coast Section to hold its first annual convention at Riverside in April. There are many reasons why the executive committee may accept this offer.

In the first place Riverside is of convenient access over three railroads from New Mexico, Arizona, California and Nevada. The Glenwood Mission Inn has excellent facilities for a convention, a fine hall, convenient committee rooms and excellent service. Mr. Frank Miller, master of the inn, has offered rates of $4 and $5 per day. Riverside has fine golf links, good tennis courts and beautiful automobile drives. It is the center of the longest high tension transmission system in the United Sattes and offers many points of technical and commercial interest to the electrical man.

Proposed Organization of Nevada Power Men.

J. G. Scrugham, dean of the engineering department at the University of Nevada and representative of the Elko-Lamoille Power Company at the organization meeting of the Pacific Coast Section is arranging for a meeting of the Nevada power men at Reno on March 3rd. At this time it is expected to organize a sub-section for the state and discuss ways and means

A Striking Scene from Riverside in Southern California. Marguerites in the Foreground, Citrus Fruits in all Directions and Snow-Capped Mountains in the Distance

for the development of greater irrigation developments under the auspices of the power companies.

An important feature of the organization meeting of the Pacific Coast Section of the National Electric Light Association at Los Angeles on January 6th was the decision to request the national association that the manufacturers be placed on a parity with the central station members at the option of geographic sections. The Manufacturer's advice in matters of public policy, engineering construction and commercial practice is exceedingly valuable to the power companies. It seems no more than fair that he should be given an equal voice in the conduct of the affairs of the association.

INTENSIVE LOAD BUILDING METHODS AT PHOENIX.

One of the most effective new business-getting methods of record is that employed by the Pacific Gas & Electric Company at Phoenix, Ariz. The company buys most of its power from the U. S. Reclamation Service whose hydroelectric plants at Roosevelt dam and along the line of its irrigation ditches afford good continuity of service. This supply is supplemented by a steam reserve plant which the company operates at Phoenix.

The keynote of the company's commercial policy is co-operation. The employes meet at frequent intervals in an assembly room and each is paid a dollar for so doing. As an erection pay system this has proven most satisfactory. Every man has been inculcated with the idea of constantly looking out for new business.

The most generally used appliance is perhaps the electric fan. The summers are hot and very few homes are without this comfort. A number of stories told by Mr. Aller, manager of the company, indicate the interest and enthusiasm of his men.

The negro janitor, became imbued with the selling spirit. His church was not equipped with fans and with an eye to his own comfort and also to the company's revenue, he concocted a little scheme with the church cornetist. One hot Sunday the cornetist started to play, stopped, wiped his brow, played a few more notes and sat down. He tried again, flourishing his bandana vigorously but without avail. At this stage of the proceedings our friend, the janitor, walked down the aisle with two fans which he connected and started, throwing the breeze on the cornetist. Immediately there was plenty of good music and as a result the fans are now operating regularly in that church.

One of the metermen, passing a residence, heard a child practicing its scales on the piano. It was a hot day and the child was probably uncomfortable. Going to the office the meterman got a fan, went back and rang the door bell. The child stopped playing and came to the door. "Good afternoon, I have a fan I would like to put on your piano." The deed was done. Two days later the meterman called. The mother met him at the door. " I left a fan here on trial the other day," he said. "I know you did," said the woman, "and now I have to buy it. My little girl gave me no peace till I promised to keep it."

As a result of such intensive methods during the past three years the company has put 1600 fans on its lines which were already considered saturated. In addition many fans were sold by the dealers.

A carnival in the town started its gas engine generating set close to the boarding house where one of the company's laborers lived. It kept him awake nights. He told his landlady he would have to move. She was sorry, but said that the engine stopped at 11 o'clock. He got several other men to complain. As a result Mrs. Landlady interested several of her neighbors to accompany her to the city council to complain of the nuisance. The power company connected up its lines to the carnival that afternoon.

The employes are encouraged to submit suggestions tending to improve the service. Three-fourths of these are good. For example one man found out that many consumers did not care to receive receipted bills. So a line was added, "Check here if you desire a receipt." The ensuing saving in postage alone has paid the entire cost of conducting the employes' meetings since then.

These several instances are cited as illustrating what a little personal interest will do in stimulating current consumption and improving service.

FIELD NOTES OF PACIFIC SECTION N.E.L.A. COMPANY PRACTICE.

Ontario, California, "the city that charms," has been put on the electrical map by the Hot Point Electric Company, which is demonstrating the feasibility of successful manufacturing under Pacific Coast conditions. All the current used by this company, together with the requirements of this thriving city of 2200 people is supplied by the Ontario Power Company from its hydroelectric plant in the mountains which tower 7000 ft. above the valley of orange and lemon groves.

Glenn D. Smith, general manager of the power company, firmly believes in the policy that satisfied patrons are a central station's best asset. Every attention is paid to popularizing the company and its service. Mr. Smith is a leader in the town's activities, was president of the Chamber of Commerce for four successive and successful years, and an always active worker in those matters advancing the community's welfare.

The following service letters addressed to all consumers are typical of his ideas in creating satisfied consumers:

Service Letter No. 1.

August 26, 1915.

To our Patrons:

It is the desire of the Ontario Power Company to have its service the best on the Pacific Coast. The management is constantly striving to reach that condition. Our patrons have doubtless noticed the gradual improvement in the service—the freedom from interruptions, uniform voltage and better illumination. The lack of complaints from our patrons during the past two years indicates that our service has been satisfactory. There may be places, however, where we can make further improvement and we ask the co-operation of our patrons in this work. It is the wish of the company to serve you as perfectly as possible, and any suggestions for betterment will be appreciated.

We will be glad of an expression from you as to the service you receive, and ask that you fill out the enclosed card and mail to us.

Yours for better service,

ONTARIO POWER CO.

Glenn D. Smith, General Manager.

Service Letter No. 2.

November 27, 1916.

To our Patrons:

Frequently electrical appliances are out of repair and the housewife is deprived of their use. These appliances usually can be easily repaired. It is the desire of this company to be of service to its customers and we maintain a Service Department that is ready to render assistance when needed. If you have any appliance that needs attention, telephone us and we will call for it and put it in condition for service. There will be no charge except where new parts are needed.

ONTARIO POWER COMPANY,

Glenn D. Smith, General Manager.

The first letter carried with it a reply postal card, and brought but twelve complaints from 2200 recipients. These were mostly with regards to low voltage, which was corrected at once.

The second letter has been most effective in keeping appliances in use which would otherwise lie idle. The devices are picked up by the solicitor in the regular course of business and are repaired by the substation attendant at odd times. Experience shows that most of the trouble is caused by broken cords, damaged heating elements coming next. Two or three devices are repaired every day and the central station revenue thus increased correspondingly.

Of the 2¾ million kw. hrs. sold annually, about one-third is for irrigation pumping, one-fourth for commercial power, one-third for lighting and one-sixth for heating and cooking. The last named is increasing rapidly, over two hundred consumers already cooking electrically.

The cooking consumption is encouraged by a regular range demonstrator who has conducted thirty-day demonstrations in Ontario and Uplands and is ready to visit any home at any time. One solicitor devotes all his time to this class of business, following up prospects furnished by the demonstrator.

Ranges are sold at the company's net cost, plus an installation and wiring charge of $5. Each range installed represents an average initial loss of $35 which is of course compensated by future current consumption. A combination rate is made for lighting and cooking,—nine cents for the first 20 kw.-hrs., three cents for the next 150, and two cents for anything in excess of 150, with 10 per cent discount for prompt payment of bills.

These practices are thus detailed as illustrative of a small company's opportunity to build a good load by pursuing broad-gauge policies.

Notes of Member Company Activities.

F. G. Russell, manager of the Tucson Gas, Electric Light & Power Company of Tucson, Arizona, has solved the question of central station merchandising and contracting by forming the Russell Electric & Machine Company, with E. E. Russell as manager. This arrangement relieves the power company of all requests for free installations, special prices on appliances and the like and provides the contracting company with a live list of prospects.

The Nogales Electric Light, Ice & Water Company of Nogales, Ariz., are installing a new 500 h.p. Busch-Sulzer Diesel engine to care for the growth in their load incident to the recent stimulation of business, due in part to the presence of the troops on the border.

The International Gas Company at Nogales, Arizona, have two 500 h.p. McIntosh & Seymour Diesel engines in satisfactory operation and contemplate the addition of a 1000 h.p. unit to care for the power demands of mining companies in the vicinity.

Pacific Section Committees.

President R. H. Ballard has announced the appointment of the following committees:

Engineering.

J. E. Woodbridge, Chairman; Sierra & San Francisco Power Co. San Francisco.
J. P. Jollyman, Pacific Gas & Electric Co., San Francisco.
H. A. Barre, Pacific Light & Power Corp., Los Angeles.
L. M. Klauber, San Diego Cons. Gas & Electric Co., San Diego.
John Koontz, Great Western Power Co., San Francisco.
C. O. Poole, The Southern Sierras Power Co., Riverside.
Jas. A. Shepard, Deming Ice & Electric Co., Deming, New Mex.

Commercial.

S. V. Walton, Chairman; Pacific Gas & Elec. Co., San Francisco.
A. W. Childs, Southern California Edison Co., Los Angeles.
E. B. Criddle, The Southern Sierras Power Co., Riverside.
L. H. Newbert, Pacific Gas & Electric Co., San Francisco.
E. B. Walthall, San Joaquin Light & Power Corp., Fresno.
C. M. Einhart, Roswell Gas & Electric Co., Roswell. New Mexico.
J. B. Black, Great Western Power Co., San Francisco.

Accounting.

W. E. Houghton, Chairman; Los Angeles Gas & Electric Corp., Los Angeles.
M. H. Bridges, Pacific Gas & Electric Co., San Francisco.
M. B. Fowler, San Diego Cons. Gas & Electric Co., San Diego.
C. E. Mynard, Great Western Power Co., San Francisco.
B. B. Smith, Western States Gas & Electric Co., Stockton.
B. T. Story Southern California Edison Co., Los Angeles.

Additional representatives are to be appointed from Arizona, New Mexico and Nevada at a later date.

The electrically operated pump has this year found immensely profitable application in the irrigation of bean crops. The harvest of black-eye and other varieties of beans is just about completed in the Stevinson section of Merced County, of California, the yield being approximately 50,000 sacks. There are also several thousand sacks of Egyptian corn which will add materially to the wealth of that colony.

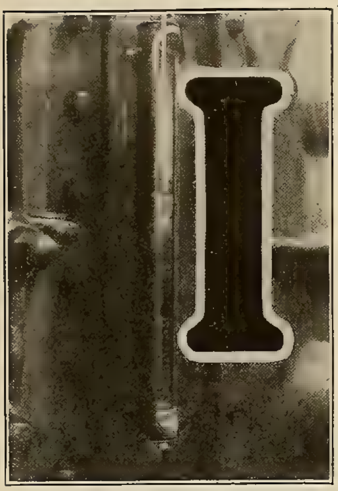
The installation of electrically operated dredges at Hanlon Heading on the Colorado River, about seven miles below Yuma and on the California side, has created much interest. It is here that the immense volume of water required for irrigation purposes in the Imperial Valley is taken from the river, and at certain seasons of the year serious loss is caused the farmers by the silting up of the canals and the corresponding water shortage. To remedy this annual condition the Imperial Irrigation District has arranged for the installation of two and possibly four electrically operated dredges of 650 h.p. each, the power for which is to be furnished by the Coachella Valley Ice & Electric Company, which is a subsidiary of the Southern Sierra Power Company. A sixty-mile 55,000-volt transmission line is now being constructed between El Centro and Hanlon Heading, and it is expected that the dredges will be in operation by April 15, 1917.

FUEL OIL AND STEAM ENGINEERING

(The subject of pressures and their proper computation is one of endless confusion in fuel oil and steam engineering practice. In this article the relationship of gage pressures with absolute pressures and the establishment of what the thirty inch vacuum really means, so often misunderstood in engineering discussion, is lucidly treated together with methods for making proper corrections when readings of the barometer are taken.—The Editor.)

THEORY OF PRESSURES IN FUEL OIL AND STEAM ENGINEERING PRACTICE.

BY ROBERT SIBLEY.



The Thermometer Suspension for Barometer Correction

IN the preceding discussions we have seen that a force is said to be acting whenever the physical conditions are such that the velocity of a body tends to be changed in magnitude or direction. If two opposing forces are equally balanced, there is simply a tendency to change motion and such a force is known as a pressure. This opposing force in the case of a gas or vapor under pressure is supplied by the walls of the containing vessel. Pressures then constitute an important phase of steam engineering practice.

The Steam Gage.—In steam engineering practice heavy pressures, that is pressures above the atmosphere, are usually measured by means of an instrument known as a steam gage. This gage consists of a piece of hollow metal bent into a circular shape which, under pressure, tends to straighten out. This straightening effect is proportional to the pressure under which the boiler is working. A rack and pinion movement, placed on the end of this curved piece of metal in the steam gage, causes the needle of the gage to indicate pressure readings. By comparing this gage with a definite standard its accuracy is ascertained.

The Difference Between Absolute Pressure and Gage Pressure.—There is a point at which a gas is said to exert no pressure. This expanded condition of a gas has never been wholly realized in practice, yet this very beginning point or zero value is most convenient in expressing pressure valuations and such denotations are known as absolute pressure values. The steam gage attached to the boiler does not read absolute pressure values, but such pressure readings are known as pounds pressure per sq. in. (gage) which means that one must add the absolute pressure of the atmosphere, P_a, to the gage reading, P_g, in order to ascertain the true absolute pressure P under which the boiler is generating steam. Thus

$$P = P_a + P_g \quad \text{.............................} (1)$$

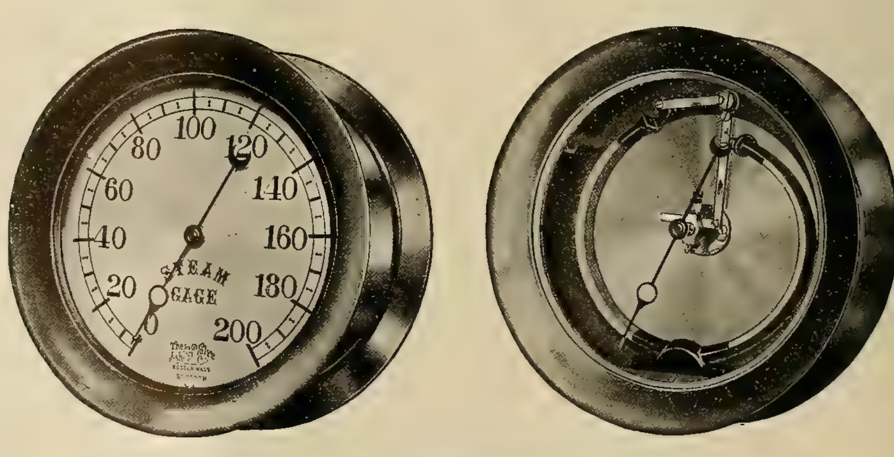
Thus, if a pressure gage of the steam boiler reads 186.4 lb. per sq. in. and the pressure of the atmosphere is found to be 14.6 lb. per sq. in., the absolute pressure under which the boiler is operating is

$$P = 186.4 + 14.6 = 201.0 \text{ lb. per sq. in.}$$

The Column of Mercury.—The most accurate method of measuring small pressures such as the pressure of the atmosphere and condenser vacuum pressure is by means of a vertical column of mercury. In its simplest form this consists of a long glass tube closed at one end and filled with mercury. The tube is then inverted and the open end placed in a vessel of mercury exposed to the atmosphere or condenser as the case may be, as shown in the illustration.

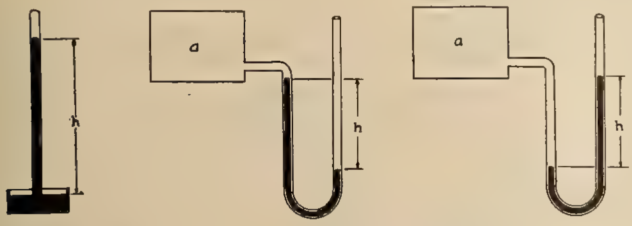
In the case of atmospheric pressure determination the mercury will at once lower itself in the long tube until the height of enclosed mercury above that in the vessel is sufficient to balance the pressure from the atmosphere without. If the barometer be at sea-level and the temperature of the mercury column 32° F., the height of mercury will now measure exactly 29.921 inches for such standard conditions.

Vacuum Pressures.—It has already been pointed out that measurement of pressure by means of the steam gage indicates a pressure over and above that exerted by the atmosphere and consequently to ascertain the true absolute pressure of the fluid under measurement we must add to the gage reading the atmospheric pressure of the day. And so in the measuring of the pressure of a condenser, unfortunately there has grown up a similar but opposite custom in which the pressure is measured down from the atmosphere. Such



Exterior and Interior View of Steam Gage, showing Principle of Operation

a reading is known as a vacuum pressure. In order then to ascertain the absolute pressure **P** under which a condenser is operating it is necessary to subtract



The Principle of the Atmospheric Rarometer, the Condenser Vacuum and the Measurement of Pressures above the Atmosphere

the vacuum pressure reading $\mathbf{P}_v$ from the atmospheric pressure reading $\mathbf{P}_a$. Thus

$$\mathbf{P} = \mathbf{P}_a - \mathbf{P}_v \qquad (2)$$

Thus if a condenser is operating under 28.5 in. of vacuum and the atmospheric pressure is 29.92 in., we mean that the actual air and steam still undisposed of in the condenser exert an absolute pressure equivalent to the difference of 29.92 and 28.50 which is 1.42 in. of mercury.

Confusion in Pressure Units.—We now see that readings in inches of mercury for low pressures and pounds pressure per sq. in. for high pressure are expressions that are not at all comparable to each other and hence their interrelation becomes an endless source of confusion.

Relationship of Pressure Units.—By careful measurement of the atmosphere at sea-level, scientists have established that the height of a mercury column with the mercury at 32° F. in temperature is 29.921 in. Such a column of mercury one square in. in cross-section weighs 14.696 lb. This gives us at once a method by which we may transfer inches of mercury $\mathbf{I}_m$ into pounds of pressure per square inch **P**. Thus

$$\frac{\mathbf{I}_m}{\mathbf{P}} = \frac{29.921}{14.696} \qquad (3)$$

Inches of Water and Pounds Pressure per Square Inch.—Very slight pressures are often measured in inches of water above or below atmospheric pressures. Thus, in determining the draft of a chimney, a "U" tube is inserted into the chimney, and the height of the unbalanced portion of the water column indicates the draft in the chimney in inches of water. Since a column of water 1728 in. high and one square inch in cross-section at 100° F. weighs exactly 62 lb., the inches of water $\mathbf{I}_w$ may be converted into lb. pressure per sq. in. **P** by the formula

$$\frac{\mathbf{I}_w}{\mathbf{P}} = \frac{1728}{62} \qquad (4)$$

The Thirty Inch Vacuum.—In engineering practice a thirty inch mercury vacuum is considered to be the point of absolute zero in pressure. This is not strictly true, however, for we have just seen that such an absolute zero point is reached under a vacuum pressure of 29.921 in. of mercury. The reading of the column of mercury in this case is taken when the mercury is at a temperature of 32° F., which is the standard temperature for scientific measurement. If, however, we change our standard to that of 58.4° F. the same weight or pressure of mercury now measures just 30.0 in. This temperature is more nearly that of the condenser room where atmospheric pressures are read and since it makes a column of even thirty inches in height, we shall adopt such a reading at 58.4° F. as standard for absolute vacuum measurement. We shall, however, bear in mind that the same column at 32° F. would stand at 29.921 inches.

The Practical Formula for Conversion of Pressures—Since we have thus established an even unit for the standard vacuum, we may also consider 14.7 pounds pressure per square inch as its equivalent instead of the cumbersome figure of 14.696 as stated above. This involves an error of four points in fifteen thousand which is negligible. Our formula for reduction on the thirty inch vacuum becomes

$$\frac{\mathbf{I}_m}{\mathbf{P}} = \frac{30}{14.7} \qquad (5)$$

To Reduce Barometer Readings to the Standard Thirty Inch Vacuum.—Although 58.4° is nearer the condenser room temperature than is the 32° F. basis, still for accurate measurement the actual temperature of the medium surrounding the mercury column should be ascertained and thus a correction must be made to reduce the height of the mercury column to what it would read if at a temperature of 58.4° F.

The Typical Condenser Barometer for Steam Turbine Operation

This is best illustrated by taking a concrete example. Let us suppose that the mercury column inserted into the condenser of a turbine reads 28.56 in. when the mercury temperature is 82° F. and that a barometer in the vicinity indicates the atmospheric pressure in the condenser room to be 30.08 in. of mercury when its mercury column is at 78° F.

The first thing to be done in the solution of this problem is to ascertain what the two mercury columns would have read had their respective mercury columns been at 58.4° F. Scientific investigation indicates that the expansion of mercury is according to the following equation in which $\mathbf{I}_t$ is the height in inches of mercury at t° F. and $\mathbf{I}_m$ at 58.4° F.

$$\mathbf{I}_t = \mathbf{I}_m\,[1.0026 + .000104\ (t - 58.4)\ ] \qquad (6)$$

Hence, to ascertain the true vacuum reading in inches of mercury we find by substitution

$$28.56 = \mathbf{I}_m\,[1.0026 + .000104\ (82 - 58.4)\ ]$$

$$\therefore\ \mathbf{I}_m = 28.415.$$

Similarly to compute the corrected barometer reading of the day, we find by substitution that

$$30.08 = I_m\ [1.0026 + .000104\ (78 - 58.4)]$$

$$\therefore\ I_m = 29.942.$$

The net absolute pressure will now be the difference between the corrected atmospheric barometer reading and the corrected vacuum reading for the condenser, which according to equation (2) is

$$29.942 - 28.415 = 1.527 \text{ in. of mercury.}$$

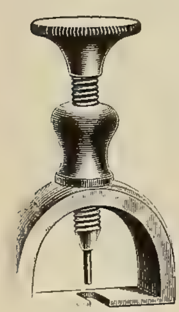
Since all standard vacuums in engineering practice are now measured on a 30 inch vacuum basis, we find that the corrected vacuum reading I_{cv} for a condenser is

$$I_{cv} = 30 - I_p \qquad (7)$$

$$\therefore\ I_{cv} = 30 - 1.527 = 28.473 \text{ in. (vacuum).}$$

For delicate scientific work this reading should be carried to still further refinements by making a correction for the expansion of the brass on the barometer scale and also for a variation in gravity at the particular place of measurement. At high altitudes and extreme northern and southern latitudes such a correction is essential.

Corrections for the Brass Scale of a Barometer.—Professor Marks in his computation of steam tables for condenser work published by the Wheeler Condenser and Engineering Company has ably discussed the correction for relative expansion of mercury and the brass scale of the barometer as follows:



A hand Adjuster for the Steam Gage

The linear expansion of brass is about one-tenth that of the apparent linear expansion of mercury exerting a constant pressure. Where a mercury column has a brass scale extending its whole height which is free to expand with changes in temperature, the readings on the brass scale of the height of the mercury column must be corrected for the relative expansion of the mercury and the brass scale. The following table is taken from table 99 of the Smithsonian physical tables and gives the constants for various barometer heights by which to multiply the temperature correction in order to obtain the corrections of the mercury column.

Reduction of Barometric Height to Standard Temperature Corrections for Relative Expansion of Mercury and Brass Scale.

Height of Barometer in inches.	Correction in inches per deg. F.	Height of Barometer in. inches.	Correction in inches per deg. F.
20.0	0.00181	28.0	0.00254
20.5	.00185	28.5	.00258
21.0	.00190	29.0	.00263
21.5	.00194	29.2	.00265
22.0	.00199	29.4	.00267
22.5	.00203	29.6	.00268
23.0	.00208	29.8	.00270
23.5	.00212	30.0	.00272
24.0	0.00217	30.2	0.00274
24.5	.00221	30.4	.00276
25.0	.00226	30.6	.00277
25.5	.00231	30.8	.00279
26.0	.00236	31.0	.00281
26.5	.00240	31.2	.00283
27.0	.00245	31.4	.00285
27.5	.00249	31.6	.00287

Example: Reading of barometer 29.84, temperature of barometer 77° F. In the foregoing table the nearest figure to 29.84 is 29.8 opposite which the correction factor is .0027. If it is desired to reduce the barometer to a 58.4° F. standard, the change in temperature is from 79° to 58.4° = 20.6° and multiplying .0027 by 20.6 we get .056 inches as the barometer correction. Subtracting this from 29.84 in. we get the barometer reading for mercury at 58.4° F. as 29.84 in. — .056 in. = 29.784 in.

Corrections for Altitude and Latitude.—Since the height of a mercury column gives true pressure readings so long as it represents a definite force or weight and since the weight or force of gravity varies at different altitudes and latitudes over the earth's surface, it is necessary to enter such a correction when the extreme refinements of the work in hand demand it. The standard value of gravity is taken at 32.173. The following formula, in which I_{mg} is the correct reading, **g** is the gravity coefficient, λ the latitude, and **h** the altitude at the point of pressure measurement, may be applied for this correction.

$$I_{mg} = \left[\frac{32.173 - .082\ \text{Cos}\, 2\lambda - .000003\ h}{32.173}\right] I_m \qquad (8)$$

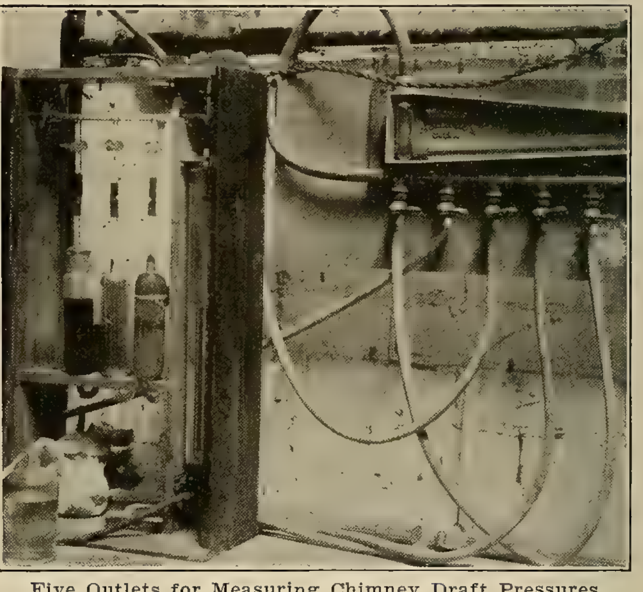
Thus in a certain engineering investigation in Berkeley, California, where the latitude is 38° and the elevation 50 ft., the condenser barometer corrected for temperature read 28.473 in. What should its properly corrected reading be when gravity is taken into consideration?

By substitution

$$I_{mg} = \frac{32.173 - .082 \times .2419 - .00015}{32.173} \times 28.475$$

$$= \frac{32.153}{32.173} \times 28.473 = 28.464.$$

Such refinements as the one for brass scale correction and especially for latitude and altitude readjustments are not necessary in most steam engineering tests. It is well, however, to bear in mind such computation in case investigations of extreme detail should arise.



Five Outlets for Measuring Chimney Draft Pressures with One Draft Gage

Errata are to be noted in the problem given on page 52 of the issue of January 15, 1917. The piston area should be 113.15 sq. in. and the mean effective pressure 77.3 lb. per sq. in. for the 50 h.p. Diesel engine cylinder there cited.

SPARKS—Current Facts, Figures and Fancy

(The world today is full of facts and figures of tremendous interest to Western engineers. Here are some boiled down items noted from a survey of thirty current magazines that should prove of interest to our readers.—The Editor.)

The income from sales of electrical energy during 1916 totaled the enormous figure of over four hundred millions of dollars.

* * *

It is estimated that in 1915 about forty thousand forest fires occurred in the United States, which burned nearly six million acres and caused a damage of approximately seven million dollars.

* * *

Exports of paper for 1916 reached the forty million dollar mark, doubling those of any previous year. No wonder technical journals find the paper required for publication purposes has gone up one hundred and fifty per cent.

* * *

The close of 1916 showed that the Public Employment Bureau of the State of California had found over forty-six thousand positions for men and women during the eleven months the state had been in the employment business.

* * *

Electric propelling machinery has been ordered for the seven latest American battleships and is specified for the four great new battle cruisers as the electric drive is considered to be superior to any other known method of propulsion.

* * *

Julean Arnold, American commercial attache to China and Japan forcefully advises American manufacturers and engineers to get the map habit and become more familiar with the location of foreign countries and their position relative to America.

* * *

The common wood box finds application in every industry. Tests at the Forest Products Laboratory, at Madison, Wisconsin, indicate that by the use of four additional nails in each end an increase of 300 per cent in the strength of canned-food boxes is secured.

* * *

Revised estimates place the amount of standing merchantable timber in the United States at approximately 2,767 billion board feet. Of this amount 1,464 billion board feet, or fifty-three per cent of the total, is in California, Washington, Oregon, Idaho and Montana.

* * *

The first extensive wireless telephone system in the world is now being put into use in Southern California on the large reserves of the Forest Department of the United States, where the inventor will be at work on the perfection of the system during the entire winter.

The United States Department of Agriculture is erecting at Summerland, California, a plant costing about one hundred and fifty thousand dollars for recovering potash from seaweed. Electrochemical industries of all kinds have unusual promise of success on the Pacific Coast.

* * *

A unique exhibit on "Home made" city planning has been prepared by George A. Damon, Dean of Engineering, Throop College of Technology in Pasadena. Coming as it does from an engineer of wide experience in municipal railway and traffic problems the exhibit is of especial interest to engineers generally.

* * *

Seventy-five thousand acres of rice were planted in California in 1916, but owing to the damage done by early rains and heavy winds only about 60,000 acres were harvested. The first sales reported were for $1.75 per hundred but the farmers are holding their stock in the anticipation of a two-cent rate. Meanwhile the electrical load for rice irrigation grows apace.

* * *

The reports do not state whether hydroelectric agricultural development had anything to do with it or not, but any rate Spider Kelly, a well-known thoroughbred steer in California recently sold for one dollar and seventy cents per pound, live weight, the highest price ever paid for a champion steer at the International Livestock Show in Chicago. In no other instance of record has beef been the highest—except when the "cow jumped over the moon."

* * *

On many of the national forest ranges across which high voltage transmission lines pass, there are areas in which various poisonous plants occur in more or less abundance. Each year the owners of live stock using the ranges lose approximately three hundred thousand dollars by the death of animals which eat these poisonous plants. In line with its other efforts to better the national forest range, the Forest Service is undertaking the eradication of the plants which cause this loss.

* * *

Dean David P. Barrows of the University of California contributes an article to the January number of the students' "California Law Review" entitled "Legislative Failure and Reform." Here he advocates a radical reorganization of the state legislature. He proposes a one-chamber body which shall meet every year. His plan calls for a permanent body chosen by the legislature to supervise and regulate the introduction of bills.

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CONTENTS

Fuel Oil Becomes an Industrial Problem

A year's review of the fuel oil market reveals the fact that the constantly advancing price of this product bids well to become a serious industrial problem.

As a consequence of an increasing demand for oil and a decrease in the storage quantities held by the pipe-line companies and purchasing agents, the market for all grades of petroleum produced in California was uniformly strong throughout the year just past. During 1916, according to the reports of the U. S. Geological Survey, the quotations posted on December 28, 1915, remained in effect until February 16, when all grades except Ventura County were advanced ten cents. A further advance of five cents, posted April 1, likewise affected all grades except Ventura County. Again, subsequent advances of five cents each, involving all grades of oil produced in the state, became effective on September 20 and November 21.

Thus the climb in market prices has been steadily upward. A moderate increase in production has been the response of California oil fields to the steady advance in prices. Drilling activity in all fields has been nearly twice as great as in 1915, but the size of the new wells completed contrasted strongly with those of three or four years ago.

Although the scarcity of oil of fuel grades has resulted in especial activity in the Kern River and McKittrick fields, still central station managers of the West are at this moment seriously pondering with much apprehension the problem of economic power development for the future.

Many claims and counter claims are being made as to the reason for the present apparent falling off in California oil production to meet the increased demand.

It is openly argued that the governmental withdrawal of oil lands for naval purposes is the cause. Others say the companies themselves are holding back the output of their best wells.

Whatever the cause is, the effect is liable to be too serious to allow idle manipulation and proper steps should be taken at once to find out the truth in the matter.

The Engineer and the New America

Like Rip Van Winkle, citizens of the United States are daily awakening from a long oblivious dream and in gazing about over the Western Hemisphere countless changes are to be observed that have taken place since the early establishment of the Monroe Doctrine and the sole guarantee by the United States of the stability of the new world discovered by Christopher Columbus.

The growth of countries to our north and south during the past twenty years has been almost a miracle. Engineers and captains of industry in the United States during this period were so busily employed that it took the cannonading of a world war to bring them to a realization of the new world factors that now are to enter into all new undertakings.

Here, for instance, is a little incident insignificant in itself yet illustrative of the new America that now must be reckoned with in future engineering and commercial matters.

A book has just been written, reviewed elsewhere in this issue, dealing with a record of an American government in the management of its telephones. At first glance we of the United States wonder in which one of the forty-eight states this government is located and it is with some dismay perhaps that we find its location is claimed in Canada.

In a word an American citizen can not longer in this broader sense be considered necessarily of the United States for some fifteen other independent states may with equal right claim this distinction.

The incident serves one important purpose and that is the all importance of every citizen of the United States getting the map habit. To engineers of the West, this is of unusual emphasis. The new field of activity of engineers of the West will undoubtedly cover many of the American countries bordering the Pacific.

And to properly render the higher ethical service demanded by his profession the new engineer must fully appreciate what it is to be in its broadest aspects a true American citizen.

Convict Labor and Hydroelectric Installation

More and more it is coming to be recognized by all students of civic economy that the convict may under proper guidance render aid to the state that will not only prove of financial assistance to its citizens but will immeasurably raise his own self-respect and keep alive the flame of possible future usefulness during his period of sentence serving.

Several commonwealths of the West have already demonstrated this fact in the employment of convicts upon certain of the public highways under a system of merit which has proved most encouraging for future application of the principle of reward in prison work.

Now comes the test for convict labor in hydroelectric installation. On another page of this issue may be found a description of the new power plant recently put into operation at the Folsom state prison in California. This installation, though small in actual output, yet possesses many interesting features. In the first place it probably establishes a new record for utilization by low heads in hydroelectric development. And in the second place convict labor was used throughout in the work involved. It is interesting to learn that the work proceeded with rapidity and without accident. All of which goes to show that under enlightened treatment, tact and discretion, the convict may become a useful economic factor in an ever-increasing number of instances where the state is in need of labor and where the convict is available to perform it.

Radio Operation for Transmission Lines

Radio telegraphy and telephony are coming to the front as important means for the protection of long distance transmission lines in times of emergency. In the case of heavy storms with the resultant damage to high tension transmission lines and the consequent interruption of service the telephone line usually goes out of commission along with the other apparatus involved.

California, the home of the long distance hydroelectric system of transmission seems to be taking the lead in evolving new and reliable means for insuring continuity of service at such times by providing a method of communicating intelligence that is independent of wires.

The continued application of radio telegraphy and telephony to problems of high voltage transmission will undoubtedly make even still more efficient the excellent continuity of hydroelectric service throughout the West.

The Southern Sierras Power Company of California has been conducting extensive experiments with the wireless telegraph as a means of communication between its power plants and substations. These have been so successful as to make probable the ultimate replacement of the present system of wire telegraphy by the wireless.

It has already been proven that the transmission line makes a most effective guide for the wireless waves. Furthermore, it is hoped to detect trouble on the line by changes in the sound given by the audion detector. Defective switches have already been located by this means, and the indications are that other sources of trouble can be located in like manner.

The evident increased service that radio transmission is about to render to the industry whence it has sprung adds again another emphatic argument against governmental control of this importance adjunct to continuity of service in the transmission of electrical energy.

Commercial Engineering in South America

Increased foreign engineering effort on the part of American engineers must of necessity go hand in hand with development of closer commercial relations with neighboring countries to the north and south.

Combination in so far as foreign effort is concerned does not in so exaggerated a manner act in the nature of restraint of trade as it does in affairs at home. In view of this fact certain legislation is now before the congress of the United States to legalize combinations so that an effective and united front may be offered to foreign competitive forces in the field and thus put further home products in the foreign field that otherwise could not be financed sufficiently to bear the high cost involved were they placed upon the foreign market single-handed and alone.

On another page of this issue is recited an interesting meeting of leading manufacturers of the United States wherein effective methods have been adopted thus put forth home products in the foreign field that to properly exploit American made goods in the profitable markets of the Argentine.

Certain of the European countries acquired their strong footing in South America prior to the present war by financing many of the daring yet feasible engineering feats that have in recent years been wrought there. It is sincerely to be hoped that American engineering talent will similarly be employed in this new field of opportunity and thus strengthen the firm commercial relations that are each day increasing in importance between the United States and the countries to the south.

PERSONALS

A. S. Kalenborn, electrical engineer of the San Joaquin Light & Power Corporation, of Fresno, Cal., was a visitor at San Francisco recently.

C. L. Cory, professor of electrical engineering at the University of California, has again assumed his collegiate duties, after a six months' leave of absence in the East.

C. G. A. Baker, vice-president and treasurer, Baker-Joslyn Company of San Francisco, after the Jobbers' Convention at Del Monte, left for a short business trip to Los Angeles.

L. G. Cushing, factory representative of the Connecticut Electric Company, recently arrived at San Francisco from Portland, Ore., on a tour of inspection. He intends to visit Los Angeles on his return trip.

W. K. Brown, district manager of the Crocker-Wheeler Company at San Francisco, has left for Ampere, N. J., where he expects to attend the sales manager's convention of his company which opens February 9th.

S. T. Harding, assistant professor of Irrigation Institutions at the University of California and a well-known contributor to the Journal of Electricity, has returned from an extended tour of investigation in the Northwest.

Albert Holmes, formerly purchasing agent with the Electric Appliance Company, San Francisco, resigned his position after 12 years' service with this company. He was also formerly assistant cashier of the Central Electric Company of Chicago.

Albert S. Hall, manager of the Hood River Gas & Electric Company, also the Hydroelectric Company of Hood River, Oregon, has resigned to become district manager of the Pacific Power & Light Company at Pasco and Kenewick, Washington.

Ross Hartley, formerly district manager of the Pacific States Electric Company of Portland and Seattle and well known in electrical circles up and down the coast, is now affiliated with the Illinois Electric Company of Los Angeles in the capacity of credit manager.

Arthur Morgan, a consulting engineer of Dayton, Ohio, in charge of the mammoth flood prevention work now under way on the Miami River, was a recent visitor on the Pacific Coast and has inspected the progress of work upon the Calaveras Dam of the Spring Valley Water Company.

E. G. Robinson, formerly general manager of the Washington Coast Utilities, and a past president of the Northwest Electric Light & Power Association, has purchased the Molalla Electric Company of Canby, Oregon, which serves light and power for the towns of Canby, Barlow, Aurora, Hubbard and Donald. Mr. Robinson will devote his time to the management of his new activities.

Luis Matte Larrain, in company with **Herman Lois**, civil engineers of Santiago, commissioned by the government of Chile, have recently arrived from the south and in company with **Horacio Johnson,** Chilean Consulate of San Francisco, will make a four month's inspection tour of the United States where they will study the hydroelectric and water situations in this country.

C. H. Johnson, for many years with the Western Electric Company in charge of the pole business, has recently accepted a position as sales manager on the Pacific Coast for the National Pole Company of Escanaba, Mich., with offices at San Francisco. This company has taken over the yards of the Western Electric Company in Oakland and will operate them with complete stock of all sizes of cedar poles. Mr. Johnson also intends to handle his old line of Carbolineum and the pole construction specialties of the Specialty Device Company of Cincinnati, Ohio.

G. D. Mantle, formerly with the Portland Gas & Coke Company at Portland and for years, sales manager Northern Electric Company at Vancouver, has recently been appointed sales supervisor for the Pacific Gas & Electric Company, with San Jose, Contra Costa, Redwood City and San Joaquin as his territory. **H. M. Crawford,** formerly district agent for the San Joaquin Street & Power Company at Bakersfield, has recently been appointed sales supervisor with Marin, Sonoma, Santa Rosa, Napa and Vallejo, as his territory. **H. C. Ross** has been appointed sales supervisor of Sacramento, Dixon, Yolo, Marysville, Chico, Auburn and Grass Valley.

George F. Haller, vice-president and general manager of the Haller-Cunningham Electric Company, of this city, has just returned from a four weeks' trip to the Atlantic and Gulf seaports. He went East to arrange for the installation of one of their wireless equipments on the steamer "Malmanger," being built at Chester, Pa., for Norwegian owners. He succeeded in closing contracts for a number of additional Norwegian and American steamers. This business together with business recently closed on the Pacific Coast, will keep the Haller-Cunningham force working well into the fall months at full capacity. The Haller-Cunningham wireless equipment is sold outright and is not leased, as has been the practice heretofore. This system has been developed on the Pacific Coast by G. F. Haller and is protected by extensive patents. This is another example of a California product being accorded wide Eastern recognition.

TRADE NOTES.

The new 1917 Diary Book of the Westinghouse Manufacturing Company has made its appearance in the trade, where its useful general information and blank spaces for business notations are finding an unusually hearty welcome.

John Woods Beckman and Herbert Emil Linden announce the formation of the Beckman & Linden Engineering Corporation for the purpose of undertaking the development and management of chemical, metallurgical, electrochemical and electrometallurgical industries, as well as hydroelectric enterprises. Their offices are in the Balboa Building, San Francisco.

William A. Cattell, Henry S. Howard and Raymond Ashton announce their association under the firm name of Cattell, Howard & Ashton, engineers. The firm is prepared to undertake engineering work in connection with the following: Steam and electric railroads, bridges, buildings, foundations, harbors and terminals, water supply and irrigation systems, industrial and manufacturing plants, sewers and sewage disposal, power developments and valuations. Their address is 68 Post street, San Francisco, California.

Samuel G. Hibben, formerly head of the engineering department of the Macbeth-Evans Glass Company of Pittsburgh, Pa., and associated with the Westinghouse Electric & Manufacturing Company, has recently become identified with the Westinghouse Lamp Company. Mr. Hibben is well known in the several electrical and engineering organizations, and particularly for his activities in the Illuminating Engineering Society, being chairman of the Pittsburgh Section. He has also been engaged in consulting work in the lighting of a number of large buildings. With the lamp company he will continue in the engineering work, furnishing expert lighting advice to the various users of Westinghouse Mazda lamps. Mr. Hibben will have his headquarters at the Pittsburgh office.

MEETING NOTICES FOR ELECTRICAL MEN

(The constant getting together of men in the electrical industry of the West has played an unusually large part in developing the now universally recognized esprit de corps that exists in this section of the country among men of this industry. Here is an account of a farewell to a prominent electrical jobber that illustrates how this underlying spirit adds much to the life and enthusiasm of electrical progress on the Pacific Coast.—The Editor.)

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION.

Samuel H. Taylor

THE meeting of the Electrical Supply Jobbers' Association held at Del Monte January 11, 12 and 13, 1917, was the largest meeting that the Association ever held. The recent regrouping plan by which Salt Lake City, Butte and Spokane were added to the Pacific Coast Division resulted in bringing into the Association three main houses, to wit: Inter-Mountain Electric Company of Salt Lake City, represented at the meeting by C. B. Hawley, Capital Electric Company of Salt Lake City, represented at the meeting by R. S. Folland and Montana Electric Company of Butte Montana, represented at the meeting by H. L. Bargion. There were also three branch houses represented, to wit: Washington Electric Supply Company of Spokane, Washington, represented by Mr. Bargion, Western Electric Company of Salt Lake City, represented by D. J. Butts, and Marshall-Wells Hardware Company of Spokane, Washington, represented by Mr. Smith.

The meeting was also important for two reasons. First, it was the annual meeting of the Pacific Coast Division, and election of officers, and secondly, there were present at the meeting the General Secretary of the Association, Franklin Overbagh, and the General Counsel, Thomas M. Debevoise.

Mr. Overbagh and Mr. Debevoise try to attend at least one meeting of the Pacific Coast Division every year, and the members of the Division consider that these pilgrimages made at some sacrifice by the general officers are exceedingly important, viewed with respect to the success of the Association.

The election of officers resulted in the selection of Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company as chairman, Albert H. Elliott as secretary, and T. E. Bibbins of the Pacific States Electric Company as the member of the general executive committee from the division.

Mr. C. C. Hillis, in retiring from the chair, made a very graceful speech introducing Samuel Taylor as one of the original babies of the division who had advanced to lusty manhood, and was now sufficiently full grown to qualify on association matters as chairman of the association. Mr. Taylor, in accepting the chair, did not deny the soft impeachment and immediately began to co-operate by ordering for the whole crowd, something you cannot find in some prohibition states with a powerful magnifying glass.

At the open meeting with the manufacturers the paper of Mr. W. L. Goodwin on Co-operation between Contractor and Jobber, was read and Mr. S. V. Walton also read a paper upon the subject, and the general counsel of the association, Thomas M. Debevoise, delivered an address of which some very good advice was given to all those present.

The usual golf dinner was held on Saturday night, presided over by the inimitable Charley Wiggins. Whether it was the impending gloom or the farewell to Billy Goodwin or just natural inspiration, wit and fun flew fast and furious for two short hours.

The several cups were presented as follows:

The Manufacturers' Trophy, a large silver bowl that had been contested for by the manufacturers and jobbers for the past year and won by the manufacturers had its final competition for permanent ownership at this meeting. It was won by R. J. Davis of the Century Electric Company. Net score 87. H. E. Sanderson had the honor of the presentation. Pure Irish wit (reflected) gave flavor to his happy remarks and Mr. Davis responded in his usual graceful way.

William L. Goodwin

C. C. Hillis, presented the Pass & Seymour and Turner Trophy to F. N. Averill, who won on a net score of 96.

W. L. Goodwin and C. B. Hawley had the honor of presenting to Judge Debevoise the old copper cup and the Del Monte Cup. Each carried the fun just a little farther than the last, so that when Judge Debevoise responded to the last prize there was little left unsaid.

Stanley Walton won the Central Station Cup and Miles Steel presented it to him. That's all.

Albert Elliot delivered the farewell address to Mr. Goodwin, who is leaving for New York to continue in a broader field the great work of co-operation that he has been engaged in for several years among the jobbers, contractors, manufacturers and central stations. Mr. Elliot's heart was in his talk and while his language is always beautiful, this speech must be recorded as the master-piece of his life. Mr. Goodwin responded very happily.

At a recent meeting of the Socket Club Mr. Goodwin was presented with a very handsome open-face gold watch, with the following inscription engraved on the case:

"Presented to Bill Goodwin from the Socket Club, Bill Berry, Bob Davis, Charley Hillis, George Harris, George Holberton, Brad Squires, Sandy Sanderson, Charley Wiggins, Tracy Bibbins."

Those in attendance were:

Alvord, R. M., General Electric Co., San Francisco.
Averill, F. N., Fobes Supply Co., Seattle.
Airey, F. J., Pacific States Elec., Los Angeles.
Allen, H. H., Landers-Frier Co.
Anderson, S. B., Pacific States Electric Co., San Francisco.
Aspenwall, C. V., Westinghouse Elec. & Mfg. Co., Seattle.
Bibbins, T. E., Pacific States Electric Co., San Francisco.
Byrne, Harry, North Coast Elec. Co., Seattle.
Butts, D. J., Western Electric Co., Salt Lake.
Baker, C. G. A., Baker-Joslyn Co., San Francisco.
Berry, W. S., Western Electric Co.
Bargion, F. L., Montana Electric Co., Butte.
Bowers, N. A., Electrical World, San Francisco.
Burger, T. E., Western Electric Co., Los Angeles.
Case, J. O., General Electric Co., Los Angeles Cal.
Debevoise, T. M. New York.
Davis, R. J., Century Electric Co., San Francisco.
Elliot, A. H. San Francisco.
Fagen, F. D., General Electric Co., San Francisco.
Folland, R. S., Capital Electric Co., Salt Lake.
Greenfield, Mr., H. W., Johns-Manville Co., San Francisco.
Goodwin, W L., General Electric Co. San Francisco.
Gregory, S. B., Arrow Electric Co., San Francisco.
Hall, C. B., Illinois Electric Co., Los Angeles.
Hillis, C. C., Electric Appliance Co., San Francisco.
Hoxie, H. H., Electric Ry. & Mfrs. Supply Co., San Francisco.
Hawley, C. B., and wife, Intermountain Elec. Co., Salt Lake.
Harris, D. E., Pacific States Electric Co., San Francisco.
Hartzell, H. F., Baker-Joslyn Co., San Francisco.
Holabird, R. D., Holabird-Reynolds Electric Co., San Francicso.
Moody, A. S., General Electric Co., Portland, Ore.
Murray, F. H. National Carbon Co., Los Angeles.
Morris J. G., Westinghouse Elec. & Mfg. Co., Los Angeles.
McDonald, R. F., Holabird-Reynolds, Oakland.
Manchester, J. C., Electric Specialties Co., San Francisco.
Nylen, A. H., Gilson Electric Supply Co., Oakland.
Newbert, L., Pacific Gas & Electric Co., San Francisco.
Overbagh, F., Chicago, Ill.
Oakes, R. E., Ever Ready Works of National Carbon Co., S. F.
Pomeroy, J. G., Los Angeles, Cal.
Quick, P. V.
Reynolds, D. L., Holabird-Reynolds Co., Los Angeles.
Russell, S. P., H. W. Johns-Manville Co., San Francisco.
Smith, W. E., Marshall-Wells Hardware Co., Portland.
Sanderson, H. E., Bryant Electric Co., San Francisco.
Steel, M. F., Benjamin Electric Co., San Francisco.
Strong, E. B., Journal of Electricity, San Francisco.
Squires, H. B., San Francisco.
Taylor, Samuel H., Elec. Railway & Manufacturers' Supply.
Vandegrift, J. A., National Lamp Works of G. E., Oakland.
Walton, S. V., Pacific Gas & Electric Co., San Francisco.
Wurfel, W. C., Westinghouse Lamp Co., San Francisco.
Wiggin, C. E., Dunham, Carrigan & Hayden Co., San Francisco.
Young, Garnett, Telephone & Elec. Equip. Co., San Francisco.
Yost, H. F., Trumbull Electric of San Francisco.
Zorn, F. J., Pacific States Electric, Seattle.

Southwestern Electrical and Gas Association.

The thirteenth annual convention of the Southwestern Electrical and Gas Association will be held April 26, 27 and 28, 1917, at Dallas, Texas. A preliminary programme will appear in these columns at an early date.

Oregon Society of Engineers.

The Oregon Society of Engineers held its regular monthly meeting Friday evening, January 19, 1917, in the ladies' dining room of the Portland Chamber of Commerce, Portland, Oregon. Philip Dater, third vice-president, presided. The constitutional amendment was passed to limit the president's term of office to one year, and not make him eligible for immediate re-election. Geo. E. Reed, presented a paper on the "Mechanical Equipment of Buildings." Jay R. Keller presented a paper on "The Selection of the Proper Type of Heating Plant for Different Buildings." The attendance was forty.

California Association of Electrical Contractors and Dealers.

A special meeting was held by the California Association of Electrical Contractors and Dealers at Solari's Restaurant, in San Francisco, as a continuation of the fourth quarterly meeting held January 19th, in which the jobbers had the floor. This meeting was the contractors' and dealers' reply to the jobbers, and many good points were brought out with the ultimate outcome that plans for closer co-operation and enlarged spheres of work were outlined. Those who participated in the speaking were: H. C. Reid, E. E. Brown, M. L. Scobey, W. D. Kohlwey, George Sittman, F. C. Newberry, George Brouillet, J. C. Hobrecht, Frank Kenny, F. E. Decker.

Joint Meeting of Portland Section of N. E. L. A. and A. I. E. E. With the Oregon Society of Engineers.

The regular semi-monthly luncheon of the local sections of the A. I. E. E., N. E. L. A. and Oregon Society of Engineers was held in the orange room of the Oregon hotel, at noon Wednesday, January 10th. Paul Lebenbaum acted as chairman and A. H. Babcock, consulting electrical engineer for the Southern Pacific Company, San Francisco, gave a talk on "The National Reserve Corps of Engineers." The attendance was seventy-six.

The bi-weekly luncheon of the local sections of the A. I. E. E., N. E. L. A. and Oregon Society of Engineers was held Wednesday noon, January 17, 1917, in the Orange Room of the Oregon Hotel, Portland, Oregon. E. F. Whitney was chairman and the entertainment was under the direction of the General Electric Company. A paper prepared by W. D. B. Dobson, secretary of the Portland Chamber of Commerce, was read by W. L. Lines on "The Industrial Activities of the Northwest." An electric flatiron and a radiant heater were given away as prizes. The attendance was forty-six.

San Francisco Electrical Development and Jovian League.

The January 17th meeting was given over to a consideration of the extensive improvements being made on San Francisco's waterfront, under the direction of the State Board of Harbor Commissioners. Mr. J. J. Dwyer, president of the board was the speaker of the day and graphically told of the completed work and of the work under construction. He said that San Francisco was now equipped with piers which could accommodate the largest ship that could pass through the Panama Canal, and further stated, that from the experience of the engineers it seemed as though the concrete pile, which have been developed to a length of 106 ft, was proving the most satisfactory in the pier sub-structure work.

President Newbert of the League announced that plans were under way for the erection of a League Lecture Bureau which would undertake to supply speakers and lectures on electrical subjects for the public schools, clubs, etc., as demands might be made from time to time for such assistance.

The meeting of January 24 proved to be one of the most interesting and instructive of the long list of gatherings ever held by this organization. William Kiefer, general agent of Wells, Fargo & Company, San Francisco, gave a talk on building up new outlets for business endeavor which will long linger in the minds of all who heard him.

Portland Sections of N. E. L. A. and A. I. E. E.

The regular mid-season meeting of the Portland Sections of the A. I. E. E. and the N. E. L. A. was held Tuesday evening at the Multnomah Hotel, January 9th. J. C. Henkle, was chairman of the meeting. Miss Edna Groves, supervisor of domestic science, Portland public schools, gave an address on "Home Economics Electrical." Refreshments of ice cream and cakes and cookies were served after the address, all of the pastry being cooked electrically. A display was made of washing machines, ranges and various other home electrical appliances. Several others present joined in the discussion, including Messrs. Clarence R. Young and J. E. Davidson of the Pacific Power & Light Company. Miss Lillian Tingle of the Oregonian, also told of her personal experience with electric cooking and highly recommended it. Geo. W. Bowen of the Northwest Electric Company, and A. C. MacMicken of the Portland Light & Power Company, both gave a short talk on electric ranges and cooking.

The meeting was not restricted to the men but included wives, friends and sweethearts, consequently this program was arranged with special interest to the ladies.

After the refreshments, dancing was enjoyed until midnight and music was furnished by an excellent orchestra. The attendance was two hundred twenty-five.

Meeting of the Electrical Jobbers, Contractors and Dealers' Association.

Held at the Palace Hotel, San Francisco, January 19th, was one of the most successful gatherings that the association has ever had. One hundred and twenty men from all branches of the inustdry were present. After a very enjoyable dinner, Frank Sommers was called upon by the chairman of the meeting, C. B. Kenny, to welcome every one present. R. D. Holabird read an interesting paper on the classification of electrical jobbers with an explanation of the discounts used by jobbers. D. E. Harris spoke on providing stocks and rendering service stating that there was $1,000,000 worth of stock available to the contractors at any time without any risk on their part. Cass Gilson told how the Mazda lamps were paying the rents of a good many dealers. C. E. Wiggins told how the jobbers and central station men should co-operate on the Mazda lamp business which is profitable to all. Mr. H. H. Hoxie told of the advantages of the electric range to the dealers and central station men. Mr. W. S. Berry told what the jobbers have done in a direct way to further the interests of the dealers. C. C. Hillis explained the financial side of co-operation work between the jobber and contractor and showed how any company was losing money on the small orders. L. Levy explained the situation from the retailers' standpoint. C. F. Butte read a paper which is published in this issue on the contractors' business methods, and A. H. Elliot, A. Yongholm, W. S. Bray gave interesting talks on Trade Acceptances. The program was concluded by short talks from Stanley Walton, Henry Holland, H. C. Reed and R. M. Alvord on co-operation.

UTILITY COMMISSION NOTES.

Notes of Arizona Corporation Commission.

All railroads in the State of Arizona are to file with the commission a statement of new mileage constructed by each company within the state from January 1, 1916, to December 1, 1916, showing whether construction was new track, siding or double-track paralleling main line, also location of same. Also estimate of additional new track constructed between January 1, 1916, and December 31, 1916.

In the matter of the application of the Northern Arizona Telephone Company for authority to sell its property, rights and franchises to the Arizona Electric Telephone Company, and in the matter of the application of the Arizona Electric Telephone Company for an order or decree of authorization to purchase and acquire all of the property, rights and franchises of the Northern Arizona Telephone Company, and to issue capital stock at par in payment therefor, the commission has granted the request.

In the matter of the application of Walapai Lighting & Power Company for a certificate of convenience and necessity, the commission has denied the request.

In the matter of the application of the Pacific Gas & Electric Company, a corporation, for an order authorizing the issue of bonds and debentures, the commission has granted permission to offer for sale sufficient bonds and debentures to reimburse the treasury of the company for the amounts expended for extensions, additions and improvements.

Notes of Utilities Commission of Idaho.

In the matter of the application of the Project Mutual Telephone & Electric Company, a corporation, for a certificate of convenience and necessity, to engage in the distribution of electric power and current, the commission has granted the request.

Sandpoint Water & Light Company, a corporation, complainant, vs. Humbird Lumber Company, a corporation, defendant. It is hereby ordered that the above named defendant be and it is hereby granted to and including February 1, 1917, within which to answer or otherwise plead to the complaint of the complainant in this cause.

NEW COURSES IN UNIVERSITY EXTENSION OF INTEREST TO ENGINEERS.

Their day's work in factory or shop over, many San Francisco mechanics are resorting to the evening classes in machine shop practice which the University of California Extension Division is conducting at the Polytechnic High School, First avenue and Frederick street, San Francisco. A new machine shop class will be organized at 7 o'clock Wednesday evening, January 17, to meet every Wednesday from 7 to 9:15 p. m. Those who complete this ten weeks' course may then take an advanced course dealing with milling machine practice, gear cutting, milling machine calculations, tool making and tempering, etc.

The beginners will be taught how to do cylindrical turning, taper turning, screw cutting, laying out and drilling holes, plain milling, etc. Men with special problems which they want to work out or special work to do will be given opportunities in these evening extension courses.

Three different courses for draughtsmen are being given by the University of California Extension Division during the half-year which began January 16, at the Polytechnic High School in San Francisco. An elementary course teaches the use of instruments, the making and reading of working drawings, and simple intersections. A second course in machine drafting deals with power transmission machinery, riveted joints, couplings, clutches, belt and rope drives, etc. A third course deals with electrical design, including the laying out of circuits, the designing of transformers, generators, motors, etc. For those who have had training in algebra and trigonometry, a course will be offered in mechanics, dealing with the problems of structures, such as trams, cranes, and beams, and with the elements of hydraulics, acceleration problems in machinery, etc.

BOOK REVIEW.

Government Telephones. By James Mavor, Ph. D. Size 5 in. by 7½ in.; 164 pp.; no illustrations; cloth binding Published by Moffat, Yard & Company of New York City, and for sale at the Technical Book Shop, San Francisco, Cal. Price $1.00.

The author of this book is Professor of Political Economy at the University of Toronto. The book is concerned with the experience of Manitoba, Canada, in its relation to telephone problems. It is a compelling and fearless narrative of the true record of an American government in the management of a great commercial business. It tells what happened to the rates and what happened to the finances, what happened to the consumer and what happened to the taxpayer. It is essentially a vivid narrative of political intrigue and carries a lesson to every patriotic American.

In the United States we are all too prone to consider ourselves as constituting the only people that may properly style themselves as Americans. The recent growth in world progress now compels us to broaden our viewpoint and consider all Americans that occupy the mainland of the American continents.

This article or book viewed from this point of discussion, makes the book at hand of unusual interest to Americans as a whole, and in its discussion of a very live topic adds much to our present knowledge of a very knotty problem.

NEW BULLETINS.

The measurement of electrical energy, electricity meters, rates for electrical energy, is the subject matter of a recent bulletin of the University of Kansas, by Geo. C. Shead and C. A. Johnson.

"Fierro En Paz" (Iron in Peace) is the title of an interesting souvenir booklet just issued by the Dunham, Carrigan & Hayden Company of San Francisco, consummating sixty-seven years of business activity.

LATEST IN EVERYTHING ELECTRICAL

(The various university extension bureaus throughout the West are doing much in bringing rural communities in touch with the latest electric appliances. Below are briefly described an account of a traveling industrial exhibit, a new mammoth magnetic clutch and new conduit fittings for push button switches which represent interesting electrical advances since our last date of publication.—The Editor.)

TRAVELING INDUSTRIAL EXHIBITS.

The University of California extension division, bureau of visual instruction, has selected the products of the Interstate Electric Novelty Company as traveling exhibits, to be displayed in the public schools of California. It is interesting to know that these products, known as the "Franco" flash-lights and batteries, were selected by the division. We present illustrations of the display board of both the flash-lights and batteries, each showing the different stages and progress of manufacture of the product, from the rough materials to the finished goods. Each article on the board is numbered and explanatory references are printed on the lower section of the board.

Exhibit of University of California Extension Course in Visual Instruction

CONDUIT FITTINGS FOR USE WITH C-H PUSH-BUTTON SWITCHES.

Three new conduit fittings are shown in the accompanying illustration particularly adapted to C-H snap switches, Fig. 1 shows a C-H No. 7102 Surface Switch on a rectangular Crouse-Hinds fitting, and Fig. 2 shows a C-H No. 7108 round base switch installed on a standard round conduit fitting. Fig. 3 shows a C-H No. 7105 switch with special base installed on a standard Paiste taplet. The conduit fittings referred to may be used with any metal conduit of corresponding diameter and thread. The fittings are small, with a japanned or galvanized finish to match the finish of the conduit. The switches have the characteristic C-H push-button operation with a light button for closing the circuit and a dark button to open the circuit. In addition to being used on conduit systems, the switches may also be used on practically all kinds of wiring systems—wooden and metal molding, open wiring and concealed wiring. They are rated at 5 amperes, 125 volts, and 3 amperes, 250 volts, National Electrical Code Standard, and made by The Cutler-Hammer Manufacturing Company of Milwaukee.

Fig. 1

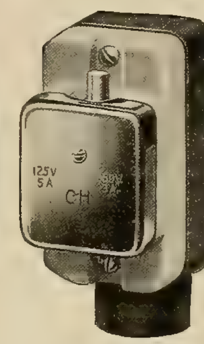
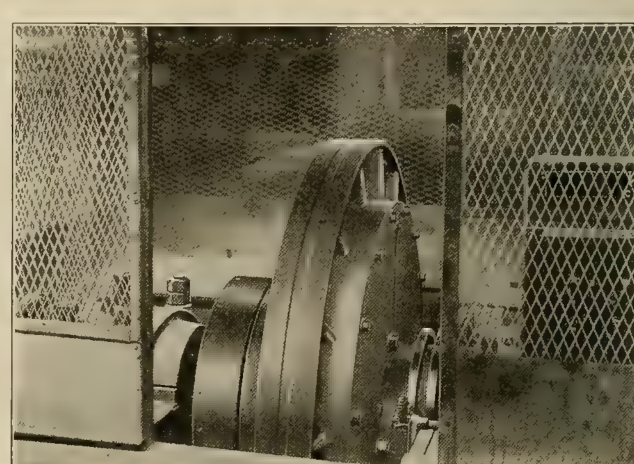


Fig. 2

Fig. 3

GOODYEAR RUBBER CO. HAS 2200 H.P. C-H MAGNETIC CLUTCH.

The largest magnetic clutch installed for rubber mill service has recently been furnished to the Goodyear Rubber Company, Akron, Ohio. This is a 78-inch clutch with a capacity of 2200 h.p. at 100 r.p.m. used on the rubber mill drive. The accompanying view shows the clutch installed. It is enclosed completely in the wire screen compartment. The clutch consists of a solid circular steel casting mounted on the mill end of the shaft. This member of the clutch carries imbedded in its periphery a single cylindrical magnetizing coil, the terminals of which are brought out to an ordinary pair of slip rings. Mounted concentrically with the coil and the outer periphery, is supplied an adjustable friction ring so that the metal faces of the driving and driven member do not come directly in contact with each other. This also serves the purpose of providing a permanent air-gap in the magnetic circuit.



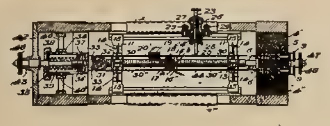
Mammoth Magnetic Clutch

WHAT WESTERN INVENTORS ARE DOING

(The dynamo-electric machine, the internal combustion engine and the wind motor still seem to occupy the attention of Western inventive talent. The method of revivifying and utilizing spent oxid described herein is of unusual interest. A by-product of lime and sulphur thus produced if economically brought about should prove of unusual importance on the Pacific Coast where the sulphur content of oil has in the past given considerable trouble in using crude oil for the manufacture of illuminating gas.—The Editor.)

1,211,770. **Micromagnetic Detector.** Frederick G. Simpson, Seattle, Wash.

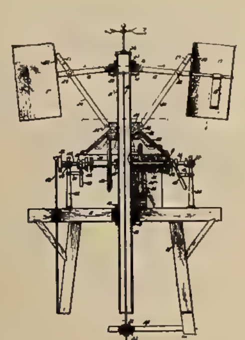
A wireless telegraph system, the combination with two suitably supported magnetizable reeds disposed at a suitable distance from and parallel with each other, of means for changing the natural and fundamental rate of vibration of each of the reeds, means for magnetically polarizing to a



desired constant degree one of the reeds, an electro-magnet disposed to extend lengthwise between the reeds, and adapted to be energized to attract the reeds each toward the other, a helix of insulated wire disposed to surround one of the reeds whereby electrical energy may be caused to change the magnetic condition of the reed, and a pair of movable electrical contact points associated with and adapted to be controlled by the reeds.

1,212,109. **Wind-Motor.** Ernest C. Rodwick, Santa Barbara, California.

A wind motor, a wind wheel including collars, means to slide one collar relatively to the other, arms pivoted at their inner ends on the slidable collar, wind blades mounted on the



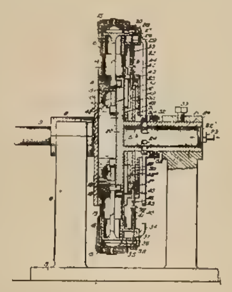
arms to rock on their own axis, arms pivoted on the second collar, and co-acting trip members on the second arms and on the blades to turn the latter on their axes by a sliding movement of the collar.

1,211,713. **Method of Revivifying and Utilizing Spent Oxid.** Emil B. Kinz, Oak Park, and Edson C. Wescott, Sacramento, Cal., assignors to Pacific Gas & Electric Company, San Francisco, Cal., a corporation of California.

The method of revivifying and utilizing spent oxid from gas works which consists in adding thereto unslaked lime and sufficiently hot water in a fluid form to extract the sulphur therefrom and separating from the oxid a soluble compound of lime and sulphur.

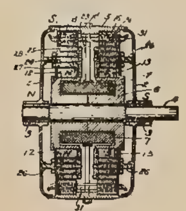
1,212,100. **Internal-Combustion Engine.** Herschel Oldham, Escondido, Cal., assignor of two-fifths to F. D. Hall, Escondido, Cal.

An internal combustion engine, the combination of a support having aligned bearings, a sleeve secured in one of the bearings, a casing mounted to turn relative to the sleeve, the sleeve extending through one side of the casing, a power shaft extending through the other bearing of the support and connected rigidly with the other side of the casing, cylinders mounted upon the casing, a piston slidably mounted within each cylinder, a piston rod secured rigidly to the piston,



an intake chest disposed adjacent each cylinder and adapted to communicate it therewith, an exhaust chest disposed adjacent each cylinder and adapted to communicate with it, a main cam plate within the casing and rigidly connected with the inner end of the sleeve, the piston rods engaging the main cam plate, an intake-controlling cam plate, and an exhaust-controlling cam plate mounted rigidly upon the sleeve within the casing, means for supplying an explosive mixture to the intake chests, mechanism actuated by the intake cam plate for delivering charges of explosive mixture from the intake chests to the cylinders, and mechanism actuated by the exhaust-controlling cam plate for discharging burnt gases from the cylinders.

1,211,617. **Dynamo-Electric Machine.** Alfons H. Neuland, San Francisco, Cal., assignor to Neuland Electrical Company, Inc., a corporation of New York.



A dynamo electric machine, means for producing a magnetic flux, a stationary element and a rotatable element adapted to be traversed by the magnetic flux, and a plurality of relatively movable elements arranged between the stationary element and rotatable element.

NEW ELECTRICAL DEVELOPMENTS

(A normal amount of new street lighting activity is recorded in new electrical development since the last issue of the Journal. The continued rumor of gigantic development of power sites along the Columbia with a view of irrigating some half million acres in the Horse Heaven region by pumping and in addition supplying power for railway electrification occupies the attention of the close follower of Western activity. In Southern California the municipal bond issue for taking over the local companies supplying the field has engrossed the attention in that district. Other interesting items may be gleaned from the following notes.—The Editor.)

FINANCIAL.

SEATTLE, WASH.—The superior court is asked to enjoin the issuance by the city of $390,000 in bonds for a municipal steam plant for the generation of electricity on Lake Union, and $60,000 for a water department pumping station and standpipes at Green Lake in two suits filed by Bruce C. Shorts of the law firm of Ballinger, Battle, Rulbert and Shorts as a taxpayer. Action is based on the contention that the city cannot issue the bonds without submitting them to the voters.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company is offering a new issue of first preferred 6 per cent stock. The new preferred stock is non-assessable and tax free, and is not subject to normal federal income tax. This stock has preference over $34,035,858 of common stock which has a present-day valuation of about $20,000,000.

LOS ANGELES, CAL.—When the proposed $12,000,000 power bonds are voted, and the distributing system of the Southern California Edison Company and the Pacific Light & Power Company taken over by the city, sufficient money will be set aside from the sale of power and paid into the city treasury by the power department to care for the interest and sinking fund not only of the new issue of $12,000,000 but all former power bond issues amounting to $10,000,000.

INCORPORATIONS.

ELMA, WASH.—The Elma-Matlock Telephone Company has filed articles of incorporation.

JEROME, ARIZ.—Articles of incorporation have been filed by the Oak Creek Power Company. The incorporators are O. S. Chick and Andres Nestaire of Cornville, Yavapai County. Capital, $750,000; principal place of business, Jerome, Ariz.

PHOENIX, ARIZ.—Articles of incorporation have been filed by the Hydro-Power & Irrigation Company with a capital stock of $1,000,000. The officers and directors are Lemon L. Osborn, R. L. Osborn and D. H. Osborn. The incorporators are: Frank Putzell and Ronald L. Osborn of Phoenix. The principal place of business in Arizona shall be Phoenix.

ILLUMINATION.

DOUGLAS, ARIZ.—The bid of the Douglas Traction & Light Company for the lighting of G avenue and Tenth street, viz., $14,750, has been accepted by the city council.

LOS ANGELES, CAL.—Bids are being received by the board of supervisors for installing an addition to the system of street lighting in the Verdugo lighting district.

CASA GRANDE, ARIZ.—As soon as preliminaries of receiving bids and making contracts can be finished work will begin on the municipal water and electric lighting plant.

SANTA BARBARA, CAL.—The city council has ordered lights to be placed at Los Olivos and Laguna streets, and at State and Mission streets.

KENDRICK, IDAHO.—The local electric light and power company is about to start work on the construction of a high tension transmission line to Moscow. The material for the work has been ordered.

SAN RAFAEL, CAL.—Mr. Kane, who has held the Novato lighting franchise for the past five years, appeared befor the board of supervisors, asking to have his franchise renewed.

FRESNO, CAL.—Bids are being received by the board of trustees for the installation of the electrolier lighting system upon "J" street from Inyo street to the southeast line of Los Angeles street.

BURBANK, CAL.—Bids have been called for by the board of trustees for the erection and constuction of ornamental street lights on Second street, otherwise known as San Fernando boulevard.

SAN FRANCISCO, CAL.—The office of constructing quartermaster, Fort Mason, Cal., has called for bids for installing an electric lighting system for the officers' quarters, Presidio, San Francisco.

MESA, ARIZ.—The town has made a formal offer of $113,000 for the purchase of the South Side Gas & Electric Company's plant. It is understood that this offer will be accepted if preliminaries are satisfactory.

SEATTLE, WASH.—The Pacific Lamp & Supply Company has been awarded the contract for the 450,950 electric lamps, which the light department will need during 1917, by the board of public works at the cost of $100,000.

INDEX, WASH.—The city council has instructed the city attorney to frame an ordinance authorizing an election for a vote on the construction of the proposed $20,000 municipal lighting plant in this city. Plans for the project have been completed by Consulting Engineer G. N. Miller, of Seattle.

MONTEBELLO, CAL.—The board of trustees has authorized the publication of a notice to sell the franchise to lay, construct, maintain, use and operate pipes, pipe lines, mains, and conduits for carrying and distributing gas to be used for heat, light and power.

SACRAMENTO, CAL.—The Electrical Supply Company has been awarded the contract for installing electroliers to be placed in front of the court house on its bid of $3565. The contract for lighting fixtures at the nurses' home and surgical ward at the county hospital has been awarded to J. C. Dolan, for $978.

REDONDO, CAL.—At a meeting of the board of trustees the city clerk gave the result of the straw vote held for installation of ornamental lighting system in Diamond street. The result showed that electricity was the favorite and the petition was granted. The city engineer was instructed to take the necessary steps for the improvement.

WOODLAND, CAL.—Foremost of the 1917 plans is a lighting system for the entire city. A distinctive feature of this lighting system is to be a white way line of electroliers along Main street from the Southern Pacific tracks to Cemetery avenue, with at least four lights to the block.

EVERETT, WASH.—Word was received here that G. N. Miller of Seattle has been granted a special commission by the council of Index in Snohomish County, to prepare plans and engineering data for the construction of a municipal lighting plant. The plant will be financed by a bond issue, and work on the plant is expected to begin in three months.

WHITTIER, CAL.—The contract for the erection of ornamental lighting posts for Philadelphia street has been signed and John W. Wilson of Los Angeles will have charge of the work. The posts are of reinforced concrete and similar to ones in use in Anaheim and Santa Ana. The contract includes wiring, conduits and lamps.

CHICO, CAL.—The Western Gas & Electric Appliance Company has been awarded the contract for the city's part of the new electrolier system, which is to be installed as soon as the materials can be shipped from the East. It is probable the work will start early this month and be completed in about six months. The contract price is $1.24 per front foot, including a light in the center of the city park.

TRANSMISSION.

JEROME, ARIZ.—Construction of an electric generating plant with a capacity of 10,000 h.p. will be commenced at Clarkdale within the next few days by the Arizona Power Company.

KINGMAN, ARIZ.—The storm here played havoc with the Golconda power line of the Desert Power & Water Company of Kingman, the long distance line of the Arizona, California and Nevada Telephone Company were also put out of commission.

PALO ALTO, CAL.—The board of public works recommended to the city council that an election be held at an early date to vote on the issuance of bonds in the sum of $75,000 for the purchase of two additional Diesel engine units for the power plant.

HONOLULU, HAWAII.—Plans are being considered by local Japanese and Chinese business men whereby the next Hawaiian legislature will be petitioned to grant them a franchise for the manufacture and sale of electricity for lighting and other purposes.

RIVERSIDE, CAL.—The South Sierras Power Company is rushing repairs to its great steel tower line in Inyo County, which suffered extensive damage during the recent storm. The total damage in Inyo County was $100,000, and the Sierras Company was the heaviest loser.

CROCKETT, CAL.—For some months the Great Western Power Company has been working for the betterment of its service in this county. They have purchased a 9 acre tract on the hill west of Valona. On this land an electric substation will be built similar to the one at Clayton.

STAYTON, ORE.—The Crown Mining & Milling Company, located near Elk Horn has been purchased by a California man. The new owner will install a mill on the Little North Fork of the Santiam River soon. The mill is to be operated by electricity and constructed at the cost of $20,000.

PRESCOTT, ARIZ.—The contract has been awarded and grading started for the auxiliary electrical plant for the Arizona Power Company to cost approximately $1,000,000. The plant will have a capacity of 10,000 h.p. and will be connected with lines radiating from the company's Fossil Creek works. The site of the plant is on the Verde River about 3 miles above Clarksdale.

PORTLAND, ORE.—The Molalla Electric Company of Oregon, operating electric light and power franchises in Canby, Hubbard, Aurora, Barlow and Donald, and the surrounding rural districts, having stock valued at close to $75,000, will change ownership very soon, as a contract has been drawn up for the sale of the property and papers for the transfer of the stock are in readiness for the negotiations, according to the attorneys. Miles C. Moore, banker of Walla Walla, is the owner of the company and E. R. Robinson, manager of the Jim Creek Light, Water & Power Company, will buy out his power plant, situated near Canby on the Canby River, and transmission lines. Robinson is a former governor of Washington and president of the State Association of Electrical Engineers. His power plant is located at Arlington, Wash.

TRANSPORTATION.

FULLERTON, CAL.—The Pacific Electric Railway Company has applied to the board of trustees of this city for a franchise.

GRASS VALLEY, CAL.—The board of supervisors have granted a right of way to the Empire Mines Company for an electric railroad from the Empire to the Pennsylvania mine, near Grass Valley.

SAN DIEGO, CAL.—The common council has granted to the Los Angeles & San Diego Beach Railroad Company a franchise to construct, operate and maintain a double-track street railway within the city limits.

OXNARD, CAL.—The Ventura County Railroad Company is having a survey made with the expectation of extending its lines to the beach. The extension will be made either from Patterson Ranch or from South dump through the Lehmann ranch.

PETALUMA, CAL.—The Northwestern Pacific Railroad has asked and received permission to lay 5 tracts across Fourth street in Point Reyes. It is generally believed that this means the extension of the electric line from Manor to Point Reyes station.

VISALIA, CAL.—The Visalia Electric Railroad Company is planning still further improvements, it is declared, among which is the decision to use the new gas-electric motor for passenger and freight service on the new extensions on the east side, and eventually into Visalia, instead of the overhead trolley system.

LOS ANGELES, CAL.—The cost of a group of new buildings to be erected for use of the Pacific Electric Railway Company at Torrance will be about $500,000. It is planned to erect about 14 buildings, which will cover an area of approximately 30 acres. Among the buildings will be a machine shop, paint shop, freight shop, blacksmith shop, power house, storage and office buildings.

LOS ANGELES, CAL.—The Pacific Electric Company has filed in Santa Ana an application to condemn for right of way purposes certain lands between La Habra and Fullerton, stating that it is the intention of the company to extend its lines to connect up the Los Angeles-Riverside gap of the Whittier-La Habra line and to build an additional line from La Habra to Santa Ana. It is probable that the cost of the new line will reach $50,000 per mile.

WENATCHEE, WASH.—It is reported that the Milwaukee R. R. Company will spend $150,000,000 in the Columbia River basin, if the bill, on which F. K. Lano is now working for the leasing of water from streams and water power sites is passed. There is a probability of an electric line being built from Priest Rapids to tap the Wenatchee and Okanogan valleys. Other phases of the big project are said to include the development of 400,000 acres of land along the Columbia by a pumping system for irrigation.

SANTA ANA, CAL.—A double track line from Los Angeles to Santa Ana via Whittier, La Habra, Fullerton, Anaheim and Orange is claimed as one of the plans of the Pacific Electric Railway Company, and it is said that plans are already prepared for the extension. Whittier boosters have staretd a movement to have the Whittier line extended southward to join the La Habra line. The completion of the rumored extension south to Santa Ana would give this city two direct lines to Los Angeles.

TELEPHONE AND TELEGRAPH.

POMONA, CAL.—The Pomona Valley Telephone & Telegraph Union plans to erect a two story brick building on Louisa street, which will cost about $21,293.

PHOENIX, ARIZ.—The Mountain States Telephone & Telegraph Company are constructing a new toll line that will go from here to points in the northern part of the state.

BOISE, IDAHO.—E. H. Dewey of Nampa, owner of the Evening Capital News, has purchased a three-story building, formerly owned by the Independent Telephone Company.

ANTIOCH, CAL.—J. McBirney, who has charge of the engineers' department of the Pacific Telephone & Telegraph Company, stated that the company would make an expenditure of about $13,000 in providing very latest improvements.

TACOMA, WASH.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for telephone and power transmission lines between the Pacific Coast Torpedo Station, Keyport, Wash., and the Puget Sound Navy Yard, also an electric transmission line from the Olympic Power Company's pole line to the radio building.

LOS ANGELES, CAL.—Approval has been given by the council to the proposed ordinance and agreement for the transfer of the Home Telephone Company's franchise to the Southern California Company. It is stated that it will require about a year to fully construct the physical interchange that will take care of the two companies, and the cost will be about $750,000. It will be necessary for the Southern California Company to enter into an agreement immediately to extend service to the Palms, San Pedro, Wilmington and adjacent territory.

IRRIGATION.

LINDSAY, CAL.—The Strathmore Irrigation district's loss last week in the high water washout on construction work on Kaweah was close to $1000.

COLUSA, CAL.—Directors of the Cheney Slough Irrigation Company have awarded the contract for the 26 in. pump and 200 h.p. motor to G. W. Tibbets.

SUSANVILLE, CAL.—Organization of the Long Valley Creek Irrigation District will be perfected early in January. Water in this district will be distributed over an area of approximately 34,000 acres.

FAIROAKS, CAL.—Fairoaks residents have signed a petition asking the supervisors to call an election for the formation of a Wright Irrigation District. The petition will be presented to the board on February 5th. The proposed district will include 3600 acres. The cost of the project is estimated at $125,000.

MERCED, CAL.—The Crocker-Huffman Land & Water Company has commenced the construction of a $10,000 spillway at the end of the Livingston Canal of the company's irrigation system and is preparing to establish a second construction camp in the Livingston vicinity to commence rebuilding the canals of the system there.

PORTLAND, ORE.—The construction of the proposed Horse Heaven irrigation district, which contemplates the reclamation of 300,000 acres of land between the Yakima and Columbia rivers in eastern Washington, would cost, complete, $24,553,438, according to a report made by O. Laurgaard, consulting engineer to the directors of the district.

PORTLAND, ORE.—A majority of the members of the legislature were present at the Oregon Irrigation Congress when it opened at the Imperial Hotel, and many important matters were discussed directly affecting irrigation. The members of the legislature were present primarily to study the irrigation situation and to learn from the congress its recommendations for irrigation laws.

ANDERSON, CAL.—At the mass meeting of Anderson-Cottonwood Irrigation District land holders, the only definite action taken was the adoption of a resolution asking the legislature to amend the Wright law, under which the district is organized, to permit the voting of a second bond issue before all funds raised by the first bond issue have been expended. Engineer Means declared the district had received full value for the money already expended, but stuck to his estimate that it would require $488,000 additional to complete the project, as originally planned.

PARADISE, CAL.—The tentative date for the $350,000 Paradise Irrigation District bond election has been set for February 7. The district proposes to build a storage dam on Little Butte Creek and install a pipe system for the distribution of water. The plans for the system have been approved by the State Engineer's office. William H. Lewis, president of the Lewis, Wiley & Morse Construction Company, has just finished inspecting the dam and reservoir site of the Paradise Irrigation District for the purpose of placing a bid on the construction work.

SACRAMENTO, CAL.—The Yolo Water & Power Company, which controls some 335 miles of main canals and laterals in Yolo County, distributing water taken from Clear Lake, 100 miles away, is preparing for a large increase in the acreage planted to rice and small orchards generally, according to W. G. De Celle, who at the time of the reorganization of the company last September was made president and general manager. The company is increasing its irrigating capacity at every opportunity and last year took over a number of privately owned ditches, developing them into major canals with large capacities and connected with the main canal.

VISALIA, CAL.—The second step in the big water suit of the Tulare Irrigation District against the newly created 2,000,000 Lindsay-Strathmore Irrigation District, which seeks to take water from the Kaweah River basin was recorded when Superior Judge W. B. Wallace granted the defendant corporation until January 15th to prepare and file its answer. Recently the court overruled the demurrer of the defendant and ordered the case to trial, thus deciding in favor of the plaintiff on the first point. The case involves the right of one district to come into an entirely different water basin and take water therefrom, and will be carried through to the highest court.

BOISE, IDAHO.—Since the inauguration of the new state land board in Idaho's state government things have been happening at a rapid rate. The board also started in on a campaign to clean up numerous projects which have been hanging fire. Summarized, the board's actions follow: Indefinitely extended the time for the settlers on the Twin Falls-Oakley project in which to make final proof to the government, which virtually gives the settlers a new lease of life; instructed the attorney-general to bring action immediately in the state courts to secure a receiver for the Twin Falls-Salmon River irrigation project; instructed the attorney-general to bring suit on the bonds of the King Hill, the King Hill Extension and the Blaine County Irrigation Company projects for failure to complete work; took similar action with regard to the Big Lost River Irrigation Company, which put up a $75,000 bond; directed the Blaine County Investment Company to put up a bond equal to 5 per cent of the construction work; paved the way for cancellation of the Hedsted project in eastern Idaho.

REDDING, CAL.—An appropriation of at least $2500 with which to pay expenses of a representative to appear before congress in the interests of the Pit River project, will be asked of the Shasta County supervisors. The request for funds will be made by C. F. Smith, secretary of the Shasta County Promotion and Development Association, which organization will ask congress to approprite $100,000 for a final survey of the Pit River project. The Pit River project contemplates the irrigation, the development association claims, of approximately 60,000 acres east of the Sacramento River, and east and northeast of Redding. Hopson's report says the area includes about 55,000 acres. The plan is to take water from the Pit River by means of a high diverting dam and tunnel piercing the ridge that divides the Pit River basin from those of the small eastern tributary stream of the Sacramento lying immediately to the south. Hopson's estimate is that the total cost of the proposed project would be $3,417,000.

Devoted to the Generation, Distribution and Utilization of Energy

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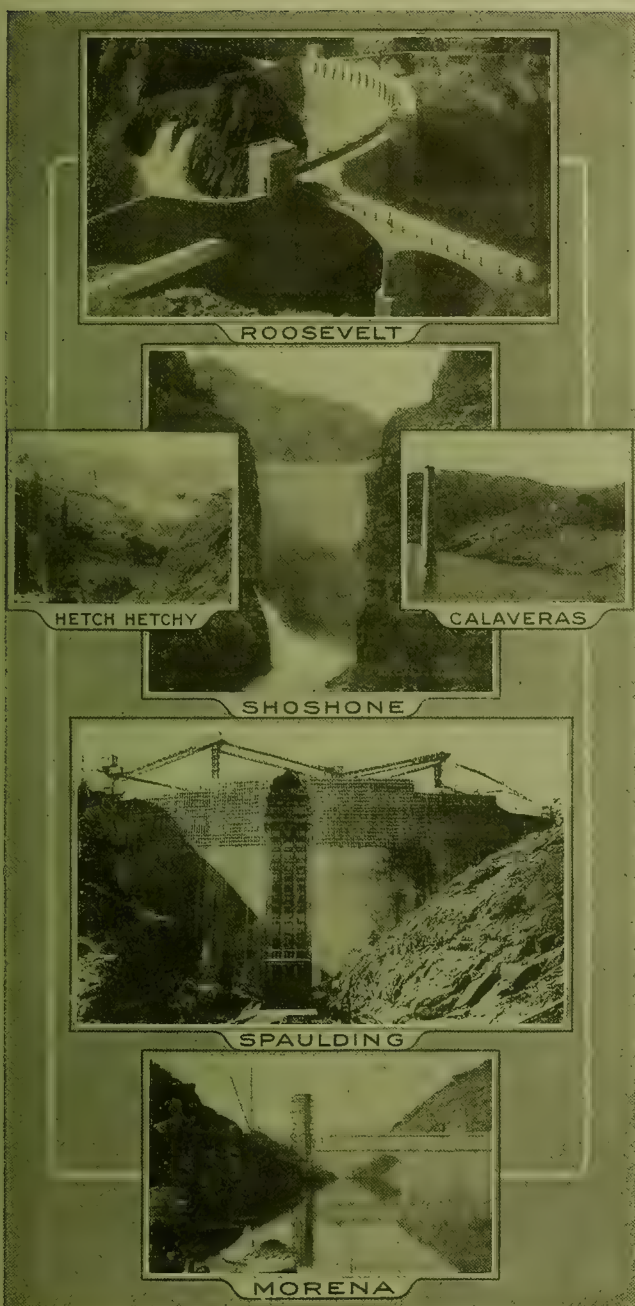

A Few Giant Creations of which the West is Justly Proud

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JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII SAN FRANCISCO, FEBRUARY 15, 1917 NUMBER 4

Handling the Dry Fill Portion at the Calaveras Dam

PROGRESS ON THE CALAVERAS DAM

(Here is an account of progress on the construction of the highest dirt dam ever attempted in the history of engineering. Engineers of the West are justly proud of the great creations here to be found in the way of dam design that have established new records and accomplished hitherto unattempted control of the forces of nature. The building of the Calaveras Dam is adding another structure to be placed along side of the Shoshone, Morena, Spaulding and other achievements of like nature.—The Editor.)

A Piece of Clay in Solid Mould from Dam

AS early as 1875 plans for the construction of the Calaveras Dam in California have been proposed, and extensive explorations have from time to time been made to determine the proper location, and character, and depth, of bed rock.

This reservoir, one of the largest in the West, is located 36 miles from San Francisco, south of Sunol, California, and is the largest storage reservoir in the Alameda system of the Spring Valley Water Company, which furnishes San Francisco with its domestic supply of water.

Since the crest of the dirt dam that is now being built in the Calaveras Valley is to tower to a height of 240 ft., thus breaking the world's record for dams of this particular type, its construction is being watched with unusual interest by engineers the country over.

In the Calaveras Valley nature has provided a huge bowl three miles long and one mile wide, with a deep and narrow outlet at its northeasterly corner. The bowl offers a splendid opportunity to form a large lake, while the narrow outlet affords an admirable damsite whereby the lake may be readily formed.

The watershed of the catchment area directly tributary to the Calaveras Reservoir covers an area of 98.3 square miles.

The largest stream within its borders is the Hondo, which is formed by the junction of the Ysabel and Smith's creeks, the last named streams passing around the east and west flanks of Mt. Hamilton and

Progress on Dam in February Compared with Last July

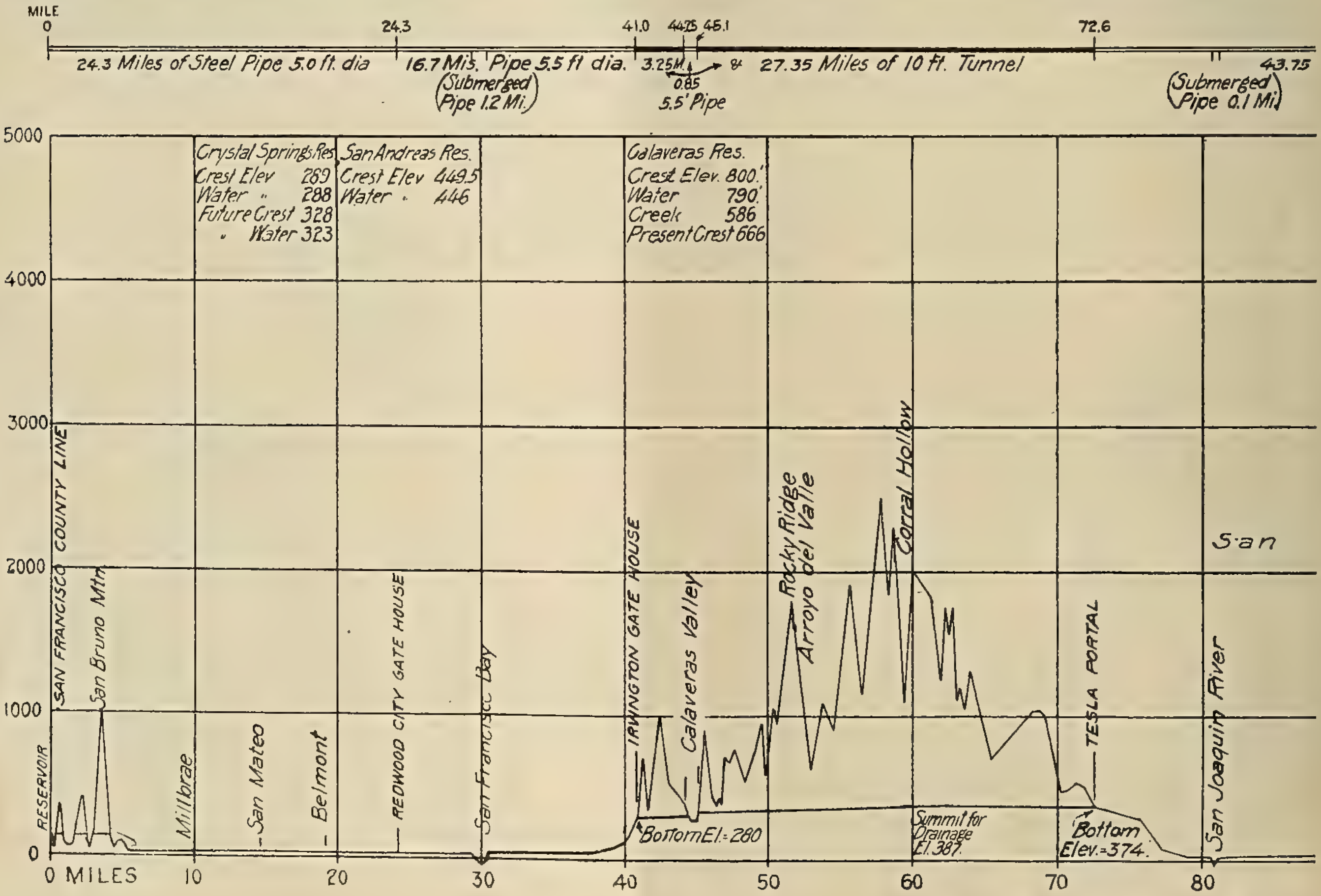
its sister peaks, which rise to an elevation of 4400 ft. In topography this area, ranging from 550 to 4400 ft. above sea level, is for the most part steep and rugged, broken by canyons leading to the main streams, and is largely covered with a dense mantle of trees and shrubs.

By means of a tunnel one and one-half miles long it is proposed to increase the catchment area tributary to the Calaveras Reservoir by diverting the waters of upper Alameda Creek, thus creating a total drainage area of over 133 square miles.

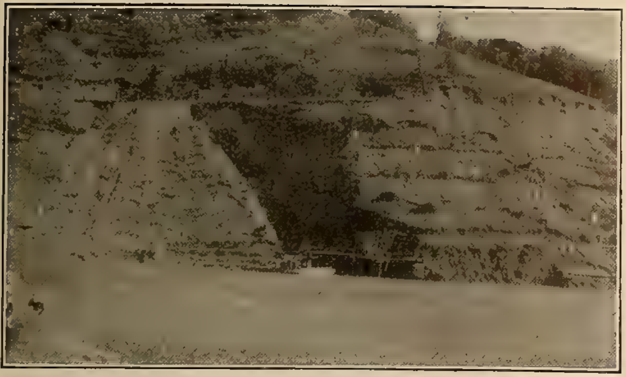
From a study of records covering a period of 63 years, the mean areal precipitation of the Calaveras watershed is found to be 28.55 inches per season. The minimum areal rainfall is 9.53 per season and the maximum 47.67 inches per season. Examination of the daily precipitation record shows wide divergence in its occurrence and intensity. At Calaveras the maximum recorded daily precipitation is 3.60 inches. There have fallen 14.94 inches of rain in one month and 25.12 inches in two months, favorable conditions for high rate of run off.

A diagram is shown herewith from M. M. O'Shaughnessy's report on the Hetch Hetchy line into San Francisco. An examination of this chart shows that the Hetch Hetchy line will pass this reservoir in the near neighborhood and at such a reduced elevation as to make full use of its storage possibilities should the city of San Francisco take over the Calaveras reservoir of the Spring Valley system.

The evaporation from the artificial lake has been found to be 60 in. and on land 4.7 in. in this district. Taking all factors into consideration it is estimated that 53,000 million gallons of water may be counted upon from this source. This means an additional 57 million gallons of water for San Francisco daily, which



The Proposed Tie-in Between the Hetch



The Pool of Water showing Stake Heights Above Yet to be Filled

The Present Impounded Waters with Cleared Timber Line for Total Raising of Water

will present facilities for doubling the present consumption of water now used by its citizens.

All of the earlier designs for the Calaveras Dam called for a dam about 150 ft. high. Finally the design of an earthen dam 220 ft. high, together with the available exploration, hydrographic and meteorological data and topographical maps of the reservoir and damsite were submitted for approval to J. R. Freeman, a consulting engineer of New York City, who advised in its stead, a concrete and earthen dam having a height of 250 ft.

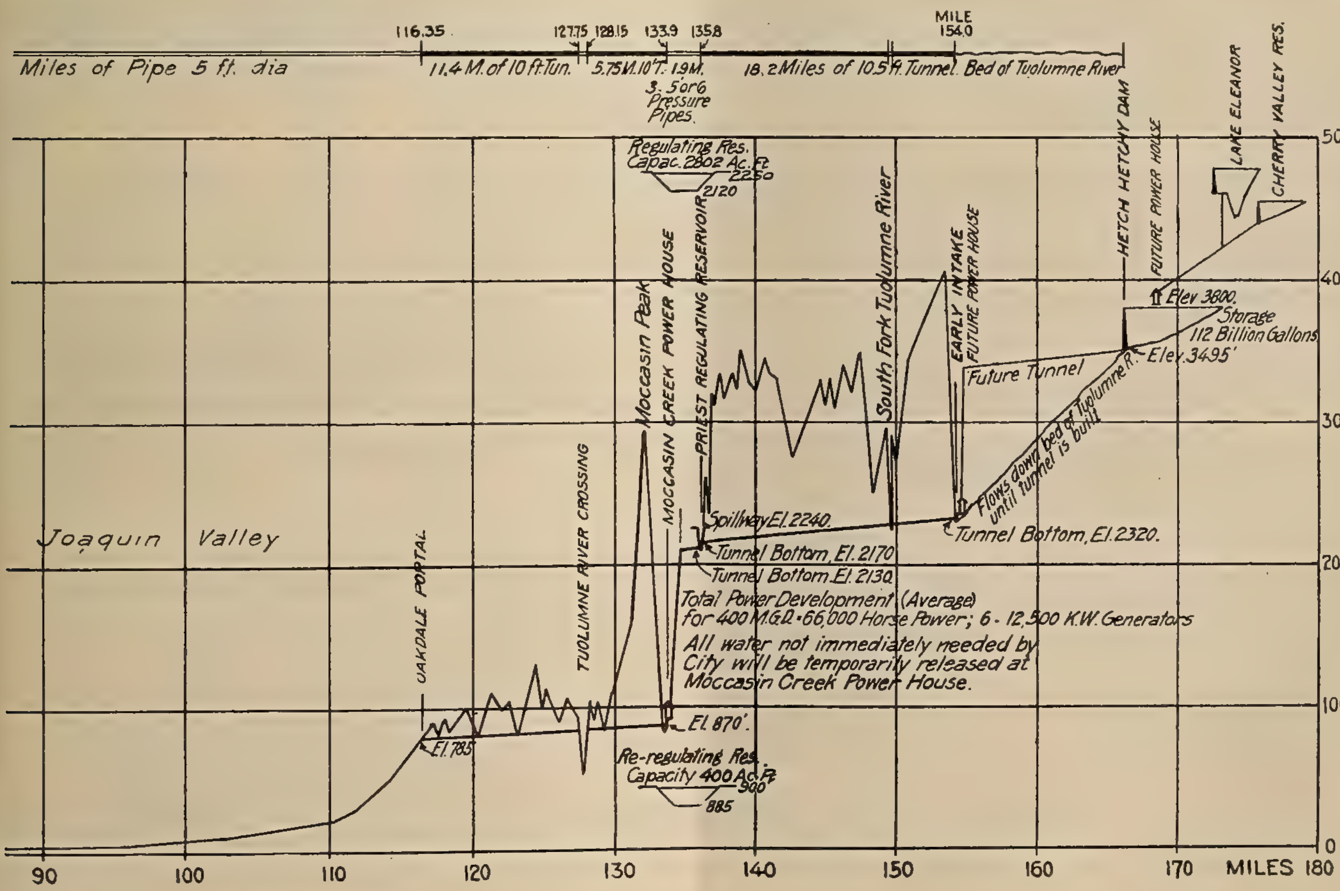
Later, however, this type of dam was abandoned and the location of the damsite up-stream several hundred feet as shown in the illustration was decided upon. At this new point it was decided to erect a dirt dam 240 ft. in height, and this is the structure that is now in course of building, as shown in the illustrations accompanying this article.

The present height of the dam is 150 ft. The white stakes shown in the illustration clearly point to the apex of the dam and its location when the dam is completed.

The slope of material on the up-stream side is 3 to 1 and that of the down-stream side 2½ to 1. The top width of the completed dam is to be 25 ft. Thus it is seen that the dam will be 1300 ft. up and down stream on the bottom and 1300 ft. across the top from side of gorge to side of gorge.

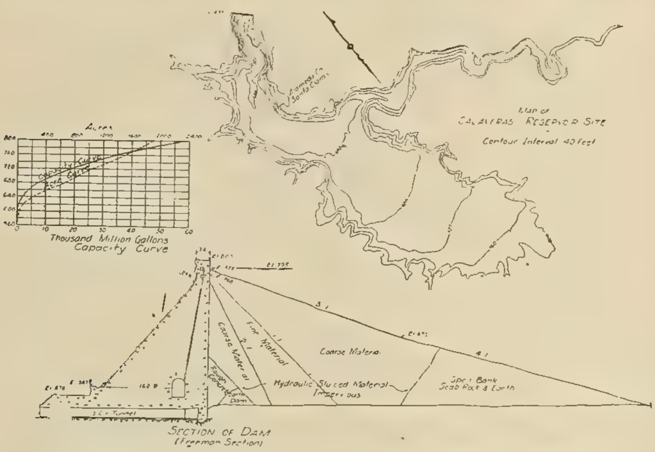
The method of construction of this remarkable dam is as follows:

Dry clay, sand and gravel is taken from the western side of the canyon and dumped on the upper and lower faces of the dam so that the width of dry material from the up-stream side to the center is about 1/3 this distance, while on the down-stream side it is ½ the distance from edge to center. The remaining



Hetchy Line and the Calaveras Dam

central portion is hydraulicked in from the surrounding hills. And it is very interesting to follow the method employed for this purpose. Since proper composition of clay, sand and gravel has been difficult to find, the total travel of such material through the pipes is some fifteen hundred to three thousand feet in places. The water for hydraulicking is pumped up from the artificial lake already formed to the hillsides above and there by hydraulic giants caused to wash the hillsides of their loose material. This material runs about 50 per cent clay and 50 per cent sand and gravel. The coarse material is crushed before passing it into the conveyance pipe. At the end of its journey through the pipes this hydraulicked material is dumped on the rims of the puddle pool. The sand



The Original Proposed Dam of Engineer Freeman showing Flooded Area

and gravel thus largely deposit at once against the dry embankment while the clay works its way toward the center of the pool thus forming an impervious mass. A mould of this clay photographed from a sample taken by the resident engineer, T. W. Espy, is shown in the first illustration.

A rather remarkable law has been found for the wear of pipes used to convey this material. For instance, with a velocity of 12 ft. per second 200,000 cu. yds. of material may be passed before the pipe must be abandoned to the scrap heap. Increase this velocity to 15 ft. per sec. and the pipe wears out almost in no time.

All pumps used for the purpose of forcing the hydraulicked material are of the centrifugal type and seem to wear out at the bottom rim first.

Some comment has in the past been made as to the slow progress made in building this gigantic structure. Any fair minded visitor upon the scene of action will come to the conclusion, however, that the dam is being hurried forward with all reasonable haste. The hardening of the central core of clay is unusually slow. While the depth of the puddle pool is only four feet, still a rod may be easily run down forty feet through the soft clay.

Test holes along the sides show that certain of the hard gravel material from the outer portion has, due to pressure, slid in toward the central core, but its immersion in the surrounding clay is so well accomplished and so compact as to leave no fear whatsoever of its impervious nature.

Summarizing the task as a whole, one is led to the conclusion that upon completion of the Calaveras dam as a whole once again the West is to present to the engineering world a feat well accomplished and passing all previous records in design of this character of dam.

The dam is being built directly by the Spring Valley Water Company under the general supervision of G. A. Elliot, who is chief engineer for the company.

GEOGRAPHIC DISTRIBUTION OF WATER POWER.

In a paper entitled The Future of Water Power in the United States, Charles W. Comstock has recently presented before the American Institute of Electrical Engineers some very valuable data.

This paper gives a careful compilation of figures showing the total fixed installed primary power in the United States and similar figures for total installed water power, at the same time calling attention to the unreliability of statistics in general. With these figures, those compiled by the commissioner of corporation are summarized and compared.

The author next takes up the question of the possibilities of water power development and points out the fallacy of power development waiting upon demand instead of creating it. The immense field for hydroelectric power which a development of the electro-chemical and electro-metallurgical industries would create with the success of such industries abroad is cited and an appeal made for a Federal policy of encouraging business enterprise instead of obstructing it.

Geographic Distribution of Water Power.

	Manufacturing, 1909. Per cent.	Central Electric Stations, 1912. Per cent.	Electric Railways, 1912. Per cent.	Total Per cent.
New England	41.5	7.4	7.4	20.9
Middle Atlantic ...	25.7	26.8	4.1	24.0
East North Central	11.4	10.0	8.9	10.8
West North Central	4.8	4.1	4.7	4.3
South Atlantic	10.1	14.1	13.6	12.4
East South Central	1.6	1.5	0	1.3
West South Central	0.2	0.2	0	0.2
Mountain	1.2	12.9	4.5	7.4
Pacific	3.5	23.0	56.8	18.7
	100.0	100.0	100.0	100.0

The Pacific coast states, without coal, and until the development of the southern California oil fields, without fuel of any kind, were quick to grasp their opportunities. What was done in other parts of the country by means of fuel, they hastened to do with the "white coal." Thus, we see that the proportion of the total central station power, which is generated by water, is much greater in the far west than elsewhere. This appears from the following table:

Percentage of Total Central Station Power Generated by Water.

New England	21.1
Middle Atlantic	22.2
East North Central	12.2
West North Central	14.3
South Atlantic	40.4
East South Central	10.6
West South Central	2.5
Mountain	64.8
Pacific	58.6

The three Pacific Coast states, with 4.6 per cent of the population, have 12.3 per cent of all the central station power in the United States. Of this, nearly 60 per cent or 7.2 per cent of all central station power in the country is hydroelectric.

Bow End View Showing Cutters

General View of Dredger "Oakland"

Pipe-Line Discharge on Marsh Lands.

Pontoon Pipe Line

ELECTRICAL OPERATION OF HYDRAULIC SUCTION DREDGERS

BY J. B. SHIPLEY

Although not an entirely new field for electrical engineering, there are so few motor-operated hydraulic suction dredgers in existence that mention of the 20 in. dredge owned by the city of Oakland and named "City of Oakland," and operating in the Oakland Estuary, may be of interest.

The principle of hydraulic dredging is a process whereby solid material, heavier than water, is transported through pipes by virtue of the velocity of a current of water.

The electrical equipment of the hydraulic suction dredge provides for the operation of the cutter, the spuds, the centrifugal suction pump and several auxiliaries. The cutter machinery is driven by a 150 h.p., 2200-volt, 600 and 575 r.p.m. variable speed motor. The motor is located in the hold of the dredge forward, on the fore and aft center line, and connected to the cutter by double reduction gearing and universal coupling. The cutter shaft is operated at 13 r.p.m. and the normal position of operation is at an angle of 45 deg. The control consists of a reversible drum controller with starting resistance.

For raising and lowering spuds, cutter head and head lines a five-drum winch is used, belt-connected to a 35 h.p., 600 and 575 r.p.m., 2200-volt variable speed motor, controlled by a reversible drum controller and rheostat of sufficient resistance to permit of 75 per cent speed reduction.

The spuds, which are two heavy weighted iron-shod timbers at the stern of the dredge, and supported from a steel gallows frame, serve to brace the dredge as the cutter moves forward into the bed of the stream, and can be raised or lowered alternately by a controlling winch. Thereby swinging the dredge in an arc, the cutter is permitted to open up a channel 150 to 160 ft. wide and cut away the bed of the stream to a depth of 30 to 40 ft. The main suction pipe extends along the steel ladder, at the end of which is the cutter, catches and conveys the dirt and water directly behind the cutter, drawing both off as it is cut away. The suction pump is of the centrifugal type, single runner, 20 in. suction and discharge, operating at 360 r.p.m It is located athwartships and directly connected by leather link coupling to a 750 h.p., 2200-volt, 3-phase, 60-cycle, 2-speed induction motor. The control apparatus for this consists of a drum controller, which handles the secondary current of the motor only, and an iron-grid heavy-duty starting rheostat, the primary being taken care of by means of an automatic oil switch.

The water and silt from the cutter are carried back over the stern of the dredge through a 20 in. C. I. pipe line connection thereon to riveted sheet steel pipe, at a rate of 450 to 600 cu. yds. per hour, with 15 per cent solids, with a velocity of 12 ft. per second, varying according to class of material handled. The long, continuous discharge pipe is made up of sections carried on pontoons and connected by flexible rubber couplings, serving to carry the material suspended in the water to the desired point of deposit.

The average cost of operation of a 20 in. dredge is about $5500 a month. Pro rata for labor, $3000; power, $2000; incidentals, $50; with 20 hours average day's run and 20 days per month.

This will make the cost under average conditions about five cents per cubic yard, which, with a competitive bid with outside dredging companies, would run ten and a half to twelve cents per cubic yard.

Of course, there are periods of heavy and light pumping, but this fluctuation is nil compared to the benefits derived from a 24-hour-per-day power consumer.—From Pacific Service Magazine.

AN EXAMPLE IN CONSTANT ANGLE DESIGN

BY L. R. JORGENSEN

(In the issue of the Journal bearing date of January 15, 1917, the author of this article established the fundamental equations for design of the constant angle arch dam, two types of which have recently been installed, the one being the great Spaulding Dam of the Pacific Gas & Electric Company and the other a construction on Salmon Creek in Alaska. In this article the discussion is carried further and concrete instances are given showing actual calculations that enter into such design.—The Editor.)

For dam sites where the abutments are close together towards the foundation and where **t** is large compared with $\mathbf{R}_u$ formula (7) gives values for the crown deflection which are too large, even assuming that the dam is entirely free to move at the bottom. While this formula considers the curved beam action, it is at the same time understood that arch action is complete. However, where the arch is thick and the distance between the abutments short, the arch becomes a wedge and the horizontal curved beam takes the greater proportion of the load as acting in this manner the support of the same load will require a smaller deflection. The deflection in the middle of a beam one foot wide held at both ends and uniformly loaded is

$$D_b = \frac{P \times 1^4}{E \times J \times 384} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7a)$$

The notations are the same as before, **P** being the unit water pressure, 1 the length of the beam, **E**

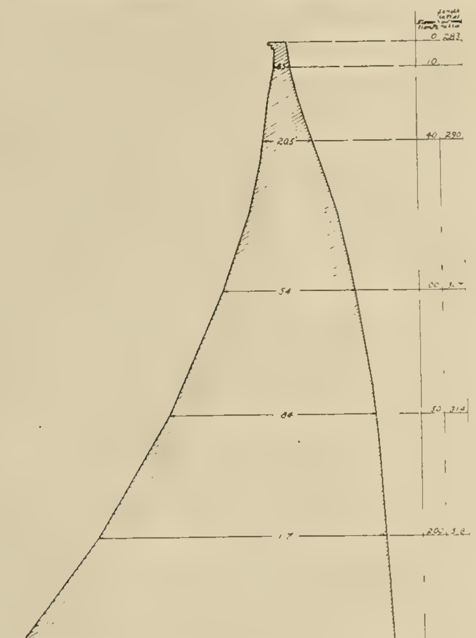


Fig. 4. The Ordinary Type of Arch Dam

the modulus of elasticity of concrete and **J** the moment of inertia using like units.

Whenever formula (7a) gives smaller values than formula (7) it is indicated that arch action is incomplete. The curved beam action tends to introduce axial tension along the downstream face in the middle and along the upstream face near the abutments, but the axial compression due to the partial arch action and lateral expansion (Poisson's ratio) will or should much more than compensate for this tendency. If it does not the design should be changed.

From curve **A** the deflection of the arch Fig 3 at the 1/3 point can be directly ascertained. It is found to be 0.132". If the cantilever 250 ft. high and one ft. wide were actually forced to deflect 0.132" at this point (Elev. 166.67 ft.) a force **F** would be required which can be found as follows (**F** is concentrated at the one-third point).

$$D_c = \frac{n \times F \times 1^3}{E \times h^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

In this formula (taken from standard handbooks) the value of **n** depends upon the rate of variation of the face slopes. If both faces were vertical **n** would equal 4. If the faces (or at least the downstream face) were shaped as flat parabolas, or if the thickness of the section in an up and downstream direction at the one-third point was approximately half the thickness at the foundation, **n** would equal 8.

This last condition is the one that theoretically fits cases in dam construction the best. Considerable modifications are mostly necessary, however, due to the fact that the rock foundation itself, to some extent, takes part in the movements of the dam body. With a full water load the rock foundation under the middle portion of an arch dam moves more in a downstream direction than does the ends, as the push in a downstream direction is the greatest in the middle and as at the ends, only a component of the axial compression acts in a downstream direction. The cantilever can therefore not take up as great a proportion of the water load as it would if fastened to an immovable foundation and more load is therefore thrown on the arch. The writer has for some time been trying to find a practical value for **n** by analyzing deflection data obtained from actual dams. He thinks he is justified in using $n = 12$ for solid rock foundation, and 16 for seamy rock foundation. This makes formula (8) empirical, but the results from it are believed to be closer to actual facts than any results arrived from mere theoretical considerations on account of the number of assumptions necessary to make.

Inserting the value of 12 for **n** in formula (8) gives

$$D_c = \frac{0.132}{12} = \frac{12 \times F \times 83.33^3}{432{,}000{,}000 \times 110^3}$$

$$F = 911{,}000 \text{ lb.}$$

The cantilever will deflect the same as the arch when thus loaded.

The total water load on a vertical slice of the dam, 1 ft. wide and 250 ft. high, is $250 \dfrac{0.\ \ 15{,}625}{2}$

$= 1,952,125$ lb. The initial stress supports $1,953,125 \times \frac{16.4}{100} = 320,312$ lb., before any deflection takes place therefore the load causing a deflection of 0.132 in. of the combined arch and cantilever must be equal to $911,000 + 1,953,125 - 320,312 = 2,543,813$ lb. The proportion of this amount taken by the cantilever will be $\frac{911,000}{2,543,813} = 35.8$ per cent.

Now, the actual load to be divided between cantilever and arch is not 2,543,813 lb. per running foot, but only $1,953,123 - 320,312 = 1,632,813$ lb. Of this amount the cantilever carries 35.8 per cent, or $1,632,813 \times \frac{35.8}{100} = 584,547$ lb., concentrated at the one-third

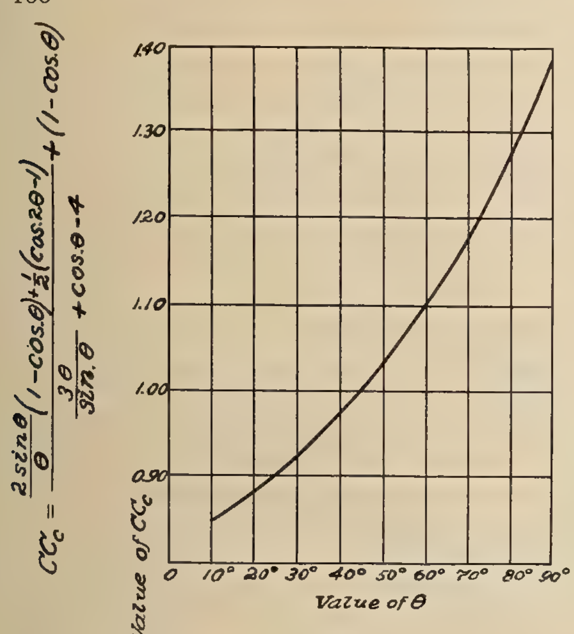


Fig. 5. Table for Values of θ

point, making the actual deflection at this point $0.132 \times \frac{64.2}{100} = 0.0847$ in.

The bending moment due to this force is equal to $584,547 \times 83.33 = 48,710,301$ ft. lb.

The section modulus of the base $= \frac{110^2}{6} = 2.011$,

and therefore the compressive stress on the foundation at the toe, due to the bending action of the water load on the cantilever, is equal to $\frac{\text{Bending moment}}{\text{Section modulus}}$

$= \frac{48,710,301}{2,011} = 24,222$ lb. per sq. ft.........(9)

The total compression on the foundation at the toe will be this compression added to that due to the weight of the structure which amount to approximately 16,200 lb. per sq. ft. at the toe, making the total compression approximately 40,400 lb. per sq. ft.

If a base length of 70 ft. is chosen, the arch would take a greater percentage of the load and the curved beam a smaller, leaving the same or less for the cantilever, but, owing to the smaller section modulus of the 70 ft. base, the compression at the toe would be somewhat higher than 24,222 lb. per sq. ft., and the compression due to the weight of the structure would be much higher than 16,200 lb. per sq. ft., so that the sum of the two would be considerably more than 40,400 lb. per sq. ft. Although within the safe limit, the resulting vertical compression would be somewhat out of proporton to the 36,000 lb. per sq. ft. (and less) axial compression used when calculating **t** from formula 1.

The dam section with the 110 ft. base contains only 4 per cent more material than the dam with the 70 ft. base (Fig. 3), as the addition is not made as a portion of a circular ring, but in the shape of a spherical triangle.

Any intermediate base length between the two limits given in Fig. 3 could be accepted for a dam built on this particular site.

The two stresses, the 36,000 lb. per sq. ft. average axial compression, and the maximum 40,400 lb. per sq. ft. vertical compression, are acting in planes perpendicular to each other, and therefore tend to support each other. Although they are low, the resulting section (Fig. 3) appears slender on account of the economical distribution of the material.

This method of calculating the vertical stress upon the foundaton is correct only so long as no tension exists at the heel, or if tension exists, as long as this tension is properly taken care of. For the constant angle arch, where the cantilever takes the smaller proportion of the load, there will seldom be occasion for tension along the upstream face, and there will perhaps never be enough tension to demand consideration. The accuracy of the result obtained from formula (8) depends to some extent upon the face slopes, especially the downstream face slope. The error, however, is generally such as to compensate for the error made in not considering that the width of the vertical cantilever, which is one foot at the upstream face, is less at the downstream face. The short cut method explained above for finding the division of the water load between cantilever and arch action, and from that for finding the total maximum foundation pressure cannot be used for dams having a crown deflection curve similar to line **B**, (Fig. 6) as this line does not show a maximum deflection near the crest, and a zero deflection at the foundation. Deflection curve **A** answers these conditions closely enough for this purpose.

Only the middle or highest dam section has been considered, as we are mostly interested in knowing the most dangerous stresses in the structure, which stresses generally occur, in high dams at least, at the downstream toe with reservoir full.

In formula (1) only average stresses have been considered in determining the thickness of each individual arch slice. The maximum axial stresses should also be investigated. These exist along the downstream face and are found from the formula:

$$Q \text{ max.} = q \times \frac{2 R_u}{R_u + R_d} \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Formula (10), however, does not give correct results towards the foundation where the arch is thick relative to the length of the upstream radius, and where the span is short. The proportion of the load carried by the arch in such a case is supported more by the curved beam than by ordinary arch action. This will cause some difference in the value of Q max. and q min.—as found from (10), adding to Q max. at and towards the abutments and subtracting from Q max. in the middle portion between the points of contra flexure on the curved beam. These points are located thus:

$$\text{Cos } \theta_0 = \frac{\sin \theta}{\theta} \quad \ldots\ldots\ldots (11) \text{ (See Fig. 1)}$$

In high dams Q max. will ordinarily be lower than the vertical compression at the toe, therefore this vertical pressure is still the most important to investigate. The influence of initial stress (Poisson's Ratio) tends to equalize Q max. and q min. in dam's sections having upstream faces of steeper slope than their downstream faces. In such sections the vertical pressure due to the weight of material above is greatest along the upstream face, and therefore the initial axial compression is also greatest. It is fair to assume that this condition of relieving Q max. and adding to q min. also tends to improve the watertightness of the dam.

In all straight gravity dams built across narrow canyons, horizontal tension exists along the downstream face in the middle and along the upstream face near the abutments, at least toward the foundation. This should be very plain when it it considered that any beam fixed at both ends and uniformly loaded will support four times as much load as a cantilever of the same length sustaining the same water load (nothing at the top and a maximum at the bottom.) In other words, whenever the beam is four times longer than the cantilever, it will support one-half of the total load, and whenever this ratio is less than four, the horizontal beam will support most of the load. The ordinary gravity design does not consider this beam action, although when the dam is built in a fairly narrow canyon the greatest portion ofthe load towards the foundation is actually carried on the horizontal beam and not on the cantilever. While adding materially to the stability of the dam (as long as the horizontal tension introduced by this beam action is not above the breaking point, and as long as the contraction joints, if any, are placed at or near the points of contra flexure only) the foundation pressure at the toe is at the same time much relieved, a very welcome feature, especially in connection with high dams.

Now if the horizontal beam be curved, axial compression takes place over the entire section, and the greater the curvature, that is the smaller the length of the upstream radius, the more load will be taken by the arch, and the less remains to cause horizontal axial tension at any point of the dam faces, due to beam action. The resultant axial compression from arch action and lateral expjansion will in general more than compensate for this tension. Lateral expansion due to the weight of the structure exists, of course,

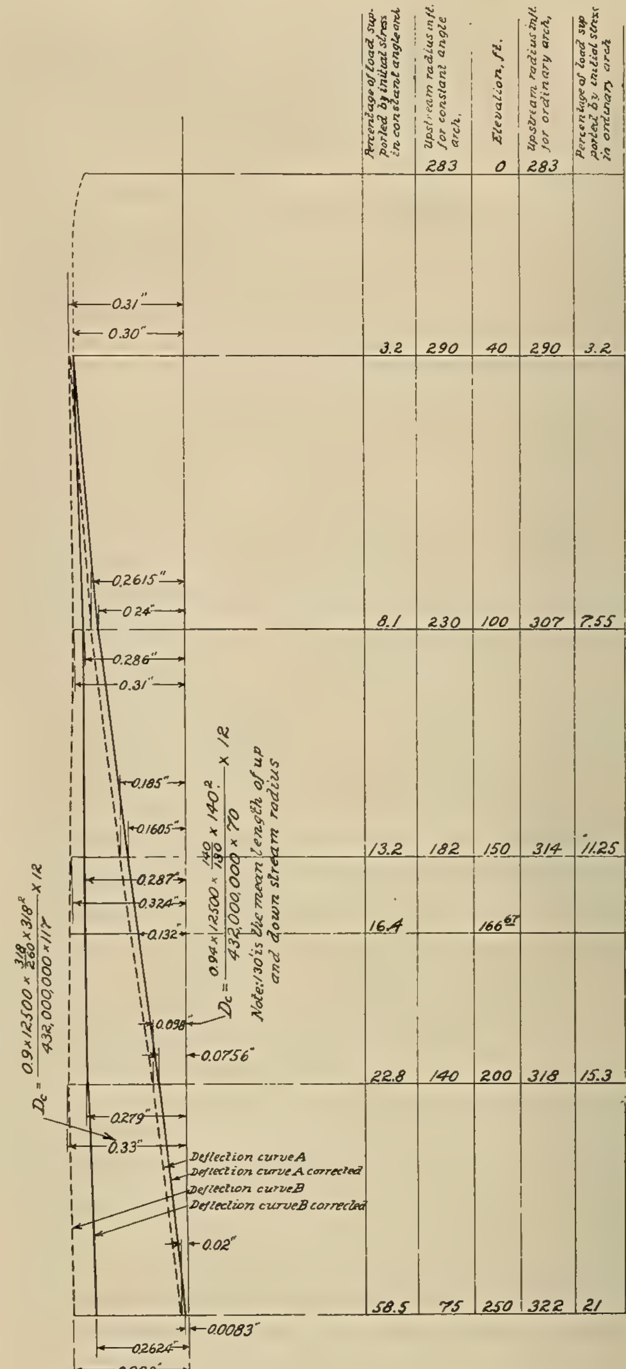


Fig. 6. Case in which Short Cut Method is Inapplicable

whether the dam is straight in plan or curve, but this alone will seldom be sufficient to compensate for the horizontal tension due to beam action in a straight gravity dam across a narrow canyon. The curvature must be introduced to eb sure of no tension existing in this horizontal beam. For a dam 250 ft. high the bottom width of the canyon would have to be well towards the bottom, and before the influence of the horizontal beam action would be negligible unless it should have failed in tension first.** It would therefore seem logical to provide even quite long dams with

** Near the top the horizontal beam would have no practical influence.

(Concluded on page 118.)

A NEW ELECTRICAL METHOD FOR TESTING WATER

BY C. A. EASTWOOD AND C. C. BROWN

(Much difficulty has in the past been experienced in determining the exact saltness of boiler water and condensate used in the large steam auxiliary plants of the West. Not only is this true but the rule-of-thumb methods now in vogue consume much time and are often unreliable. Here is an electrical method, quick and accurate, that has been developed by the authors at Station A of the Pacific Gas & Electric Company in San Francisco. Mr. Eastwood is superintendent at this power plant and Mr. Brown is technical assistant.—The Editor.)

In any steam boiler, the cleaner the boiler and the fresher the feed water, the higher will be its efficiency and the less the upkeep cost. When the feed water is dirty or salty, a heavy scale forms upon the tubes and drums, which prevents the heat of the fuel combustion from reaching the water and therefore burns out the tubes. Also, the water being salty or dirty, is more dense than if it were fresh, and consequently more fuel is necessary to turn it into steam. Besides these bad effects, when the boiler water is very salty, it has a pitting or corrosive action on tubes and drums, which tend to form blisters and leaks, so that the tubes last a much shorter time and have to be renewed oftener than if the water were fresh.

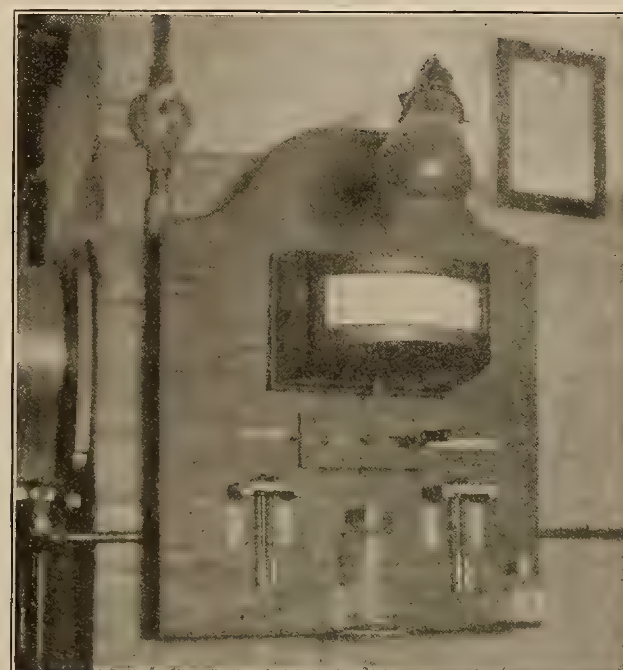
Of course, the longer a boiler is run without blowing off or changing its water, the denser the water will get, and when the boiler is run at high overloads for long periods of time, the water in it becomes very dense.

Wherever salt sea water is used as a circulating cooling medium in engine and turbine condensers, there is always found the difficulty of keeping the condensers tight and free from leaks that would allow the salt water to get into the condensate and thence into the hotwells and boiler feed water. Should this salt water get into the boiler feed water in any great quantities, the boilers soon become very dense and the effect is quickly seen on tubes and drums in the form of blisters and leaks.

At Station "A" of the Pacific Gas & Electric Company in San Francisco, there are two 15,000 kw. and one 12,000 kw. vertical turbines, besides two 4000 kw. vertical triple expansion engines, all of which run condensing. The three turbines are run every day, while the triple expansion engines are held for emergency service, or are used to build up and test out repaired cables, etc. The circulating cooling water for these machines is pumped from San Francisco Bay and passed through the condensers of the engines, turbines and auxiliaries. The condensate from the condensers is conducted to the hotwells and is pumped back into the boilers in the usual way.

To generate the necessary amount of steam to run these machines, we have 26 boilers at Station "A," 21 Babcock & Wilcox, 2 Sterling, and 3 Heine, the total rated capacity of the boiler room being 15,500 b.h.p. As the day load on the station is about 30,000 kw. and the peak load at night runs as high as 51,000 kw., it is evident that a large number of these boilers are continually run at an overload. Under these conditions, the water in the boilers would soon become very dense, should the boiler feed water become salty from leaky condensers.

Now, in order to know the density of the water in the boilers, or to know when the condensate from a condenser is salty due to leaky condenser tubes, it is necessary that we have some sort of test that will give us this information. If the condensate from one of the condensers becomes very salty, due to leaky condenser tubes, it is better to waste it than to put



New Treatment for Determining Salinity of Water

it into the hotwell and have the salt pumped into the boilers. The point is, to know how salty we can afford to let this water become before it is advisable to discard it and use the city supply water, which itself contains many scale-forming salts.

The first method of determining the presence of sodium chloride or sea salt in the condensate, used at Station "A," was to draw a test tube of the condensate from each condenser and add to it a few drops of silver nitrate. If any chloride were present it would then appear as a white cloudy precipitate, the greater the amount of salt or chloride present, the heavier would be the precipitate.

It is evident that this test merely showed the presence of the chloride in the condensate and in no way determined the amount present. If this test were applied to the city supply water, it showed a considerable precipitate, thus showing the presence of chlorides in the make-up water. Besides these chlorides, we know that there is present in this city water, other scale-forming salts such as sulphates, and carbonates that are not shown by this test but that nevertheless are deposited as a thick scale upon the drums and tubes of the boilers. These, we take care of by

the use of a feed water compound that is fed into the hotwells. This compound, however, has no effect upon the soluble chlorides which remain in solution in the boiler water.

So, the question became with this nitrate test, to determine by observation of the white precipitate, whether the condensate was better or worse than the make-up water. If better, it was put into the hotwells; if worse, it was "put on the sewer" or discarded, thus wasting the water and also the heat contained in it and using the cold city water for make-up supply.

Thus it is seen that this test amounted to nothing more than guess work, as it depended entirely upon the individual judgment of the person making the test. One water-tender might test a sample of the condensate, and viewed by him, if the light was right, he might judge it as very salty and discard it. On the change of watches, the next water-tender try a sample and take it into a better light and calling it fairly fresh, turn it into the hotwell. It was simply a matter of personal guesswork, and undoubtedly a great deal of good condensate and hot water was wasted, to be replaced by cold make-up water, itself containing more injurious salts than the water discarded.

PACIFIC GAS AND ELECTRIC CO.

CONDENSER SATURATION REPORT

STATION "A" DATE........................

GRAINS SALT PER GALLON

TIME	NO. 5	NO 6	NO 7	EXCITER	REMARKS
1 A. M.					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12 NOON					
1 P. M.					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12 M. N.					

Chart for Condenser Saturation Report

The same conditions prevailed in the boiler room. The practice was to empty and fill two boilers each night and to blow a couple of gage glasses of water out of the dead boilers and in that way freshen them up. Starting at No. 1, two boilers would be emptied and filled each night; thus No. 1 and No. 2 were emptied the first night, No. 3 and No. 4, the second night and so on until all 26 boilers had been emptied and filled. On the 14th day we would then be back to No. 1 boiler and ready to start over again.

This method of emptying and filling the boilers took no account of the condition of density of the boilers, but each one got its share of filling regardless of whether it was dense or fresh, as often as its turn came along. Thus, No. 1 boiler got emptied as often as No. 15 boiler, regardless of whether No. 15 had been running at a high overload and consequently was far more dense, or having a better draft and higher fire-box had evaporated much more water than No. 1 in the meantime.

It is true that attempts were made to determine the density of the boilers by means of the Babcock & Wilcox chromate outfit but the results obtained were neither satisfactory nor consistent, and required too much time to be performed periodically. The same is true of the alkalinity titration test, the time consumed in going over the 26 boilers being excessive.

Hence it was decided to try and find some short, quick method whereby we could test the condensate, feed water, and boiler water and know definitely, accurately and quickly, the amount of salt present in the condensate or boiler water.

This object was accomplished in the apparatus hereinafter described and which constitutes our new electrical method of test. By means of this instrument, we can test the condensate from the three turbine condensers and the hotwells in two minutes, and know definitely the amount of salt contained therein in grains per gallon of water. These tests are made at intervals of two hours throughout the twenty-four hour day, and a daily record kept on the accompanying "Condenser Saturation Report." This report shows the saturation of the condensate of No. 5, No. 6 and No. 7 turbine condensers and also the turbine driven exciter condenser, at the two hour intervals. It also states whether or not the condensate from any one of these condensers is on the line or is being discarded.

On the same instrument we can test the water drawn from the gage glass columns of all of the 26 boilers in an hour's time and know definitely, the density of each boiler in grains of salt per gallon of water.

The boilers are thus tested every morning after the gage-glass columns have been thoroughly blown, and a daily record kept, showing the condition of each one and its rate of increase in density.

Since the installation of this salt meter at Station "A," we have altered our method of emptying, filling and blowing the boilers. Each night, as before, two boilers are emptied and refilled, but now, instead of taking them in rotation along the line, we determine, by the use of the salt meter, the two densest boilers and empty these. The dead boilers are then chosen from among the remaining heaviest ones and a couple of gage-glasses of water is then blown from these each night. By the use of this method of changing water, the average density of the boiler water has been brought down from 250 to less than 50 grains of salt per gallon of water.

As is seen in the accompanying photograph, the instrument consists of a board on which is mounted a milli-ammeter, a double pole, single throw switch, a single pole, double throw switch, two sets of electrodes,

a sample measure and a bottle. Either set of electrodes may be thrown in series with the meter by means of the center single pole double throw switch.

The meter has two scales, an upper or condenser scale, and a lower or boiler scale. The upper scale is calibrated for the electrode set marked "Condensers" and ranges from distilled water or 0 grains of salt per gallon of water, to 6 grains. The lower scale is calibrated for the electrode set marked "Boilers" and ranges from 6 grains per gallon to pure sea water. The meter is calibrated to read directly in grains of salt per gallon of water on a low voltage a.c. or d.c. circuit. By being thus directly calibrated, the salinity of any sample may be read off without further reduction or conversion and the men using it soon become familiar with the relative saturations of the waters handled.

The operation of the instrument is simple. To test a sample of boiler water, throw the single pole double throw switch to the left, thus cutting the boiler electrode set in series with the meter. Fill the measure with the water to be tested and pour it into the bottle. Put the bottle over the boiler electrode set and read grains of salt per gallon of water on the lower or boiler scale.

The same procedure is followed when testing a sample of condensate on the condenser electrode set, with the swing switch thrown to the right. This time the grains of salt per gallon of condensate are read on the upper or condenser scale. In all cases the measure is filled to overflowing with the sample of water to be tested, thus insuring a constant quantity of sample and a constant immersion of the electrodes in the water.

The principle upon which the instrument operates, is that over the range which we work, 0 to 300 grains of salt per gallon of water, the reading of the meter is approximately proportional to the salinity of the sample, provided that we maintain constant immersion of the electrodes into the sample and constant voltage across the terminals of the apparatus.

The instrument is correct to within 5 per cent as the meter scales were calibrated by means of solutions of known density which had been tested chemically. In many tests that have been made since its installation, it has checked the chemical analyses exactly or within one or two grains of salt per gallon of water in one hundred, so that now we rely upon it entirely and have abandoned all other tests for salt.

The effect of this installation has been noticed in many ways. The boilers are now much fresher, the number of tubes renewed for a given kilowatt output is much smaller, thus insuring more constant and continuous service from the boilers, and the condition of the boilers is much better as the fresher water in them requires less fuel consumption and consequently less furnace repairs. Much less hot condensate is wasted than before thereby saving the heat in the condensate and also cutting down the make-up water bill, besides eliminating much of the make-up water scale that had been deposited thickly upon the tubes and drums.

In the engine room the use of this salt meter has lessened the amount of condenser work immeasurably. Under the old method of test it was simply a gamble in determining which of two condensers showed the more salty. As a consequence of this, one condenser might be taken down and repacked or tested for leaks, when in reality the other was delivering far more salt into the hotwells than the one taken down.

Again, as the least trace of salt will show a white precipitate with the nitrate test, a condenser would show salty, but to what degree it was impossible to tell. That condenser would be taken down, a dozen tubes or so plugged, the remainder repacked and upon putting the condenser in service again, the condensate would still show salty. Whether or not the night's work had done any good could only be surmised. However with the electric salt meter one can instantly tell whether or not the condensate is as good or better than the make-up water and also what effect a night's work upon a condenser has accomplished.

Condenser leaks are intermittent, and sometimes clear up by themselves. In using the old nitrate test a water tender would put a condenser "on the sewer" or in other words, waste the condensate at the beginning of the watch, and not trouble to test it again during the watch. The next man, seeing it being discarded would leave it on the sewer and although it might have cleared up in the meantime, would report it as salty. The condenser would be taken down that night, tested, plugged and perhaps repacked. As each condenser contains 6000 tubes and a man must go over the 12,000 ends looking for leaks, it is seen that much unnecessary work was done through being unable to determine the exact conditions and "working in the dark."

By the use of this simple electrical apparatus, all guess-work has been entirely eliminated as regards the salinity of boiler water or condensate, and we are now able to tell definitely, quickly and accurately the salinity of any sample of water, and by keeping the reports as described, we have a complete record of the daily performance of the boilers and condensers that has proven itself very useful.

When one considers the saving, not alone in repairs to equipment and cost of its upkeep, but also in time and labor, that has been effected by this simple home-made device, one can appreciate its value to any station or plant where salt sea water is used as a cooling medium in engine and turbine condensers.

GENERAL INTEREST IN ELECTRICAL SAFETY CODE

A large demand for copies of the National Electrical Safety Code among state commissions and companies which are anxious to have it for examination and use is an indication of the general interest in this publication of the United States Bureau of Standards. Preliminary copies printed in November were distributed to the press and to many of those who co-operated with the bureau in the preparation of the publication. Arrangements have now been made to sell the code at a low price, and it is expected that a large number will be disposed of at the nominal charge that has been fixed for it—20 cents with paper covers and 30 cents with cloth-lined covers.

ELECTRICAL COOKING AND HEATING

BY EDNA GROVES

(The home electrical is each day solving the problem in scientific and economic evolution of American domestic life. Here is a timely discussion on home economics as applied to the electrical way of doing things and should assist wonderfully in forwarding educative ideas in efficiency of the electric stove. The author is head of the department of domestic science in the Portland city schools and presented this paper before a recent meeting of the Portland Sections of A. I. E. E. and N. E. L. A. at the Multnomah Hotel, Portland, Ore.—The Editor.)

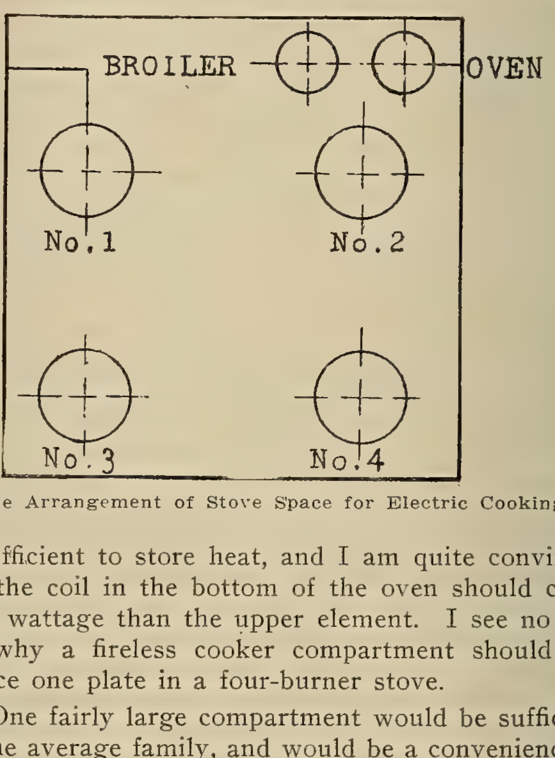
Home economics is not a new subject. Our grandmothers pioneered this work; they cared for their families and homes without realizing that housekeeping was a business and cooking a scientific process. The education of the girl of today is very different from the girl of yesterday—the girl of yesterday received practically the same school training as the boy The discipline received in this form of education was invaluable but it gave no practical training for life. Living is the big business of life, and any work whether cultural or industrial should prepare us to live.

Home-making is the business of most women and the need of preparation for it cannot be questioned. The teaching of home economics began in the agricultural colleges some forty years ago and today the elementary schools, high schools and colleges everywhere are offering this work. Women have been very slow in taking the initiative; the love of tradition has made them loathe to keep abreast of the times and many modern kitchens resemble those of our grandmothers. We have been content to sit back and watch new types of machinery go into use in the farm and in the shop without realizing that the machinery of the kitchen is out of date and methods that were useful a few years ago are not applicable today. The labor-saving devices now in use were planned by men; if these devices are practical and easy to use we buy them but we are not inclined to study them seriously enough to intelligently criticize. The stoves with ovens on the floor were used for generations without a complaint. Sauce-pans are still made with the lip on the wrong side and women still buy them. The architect plans the kitchens not to save steps but to make them. Sinks and working surfaces are placed at a back-breaking height, and women let it be done. The housekeeper of the future is today thinking of all these things. While she is in high school she plans her house on paper, she cooks an imaginary meal and places her equipment accordingly. She studies types of stoves and kitchen utensils and she is not altogether pleased with the models shown her. She has some suggestions to make and the housekeeper of the future does not hesitate to criticize present day kitchens. That the men of these two organizations realize that the housekeeper is in position to assist them in this electrical game speaks well for the future.

Electricity as a fuel for cooking has passed beyond the experimental stage. It now compares with gas for speed, and for efficiency is superior to any fuel we have. The modern electric range is as speedy as gas, easier to operate and gives the steady heat of a wood or coal stove.

The idea of the designers of electric cooking appliances seems to have been to save current rather than to make an element which would give quick results. I know the argument that it increases your load very much and that you can get results by using less current and cooking a longer time, but that is not the spirit of the age and you will not compete with gas, using the slow type of elements. An oven that takes thirty or forty minutes to heat for biscuits is too slow for practical use. The same is true of the units for the plates.

I well remember attempting to make creamed crab for a party of twenty on a closed plate attached to the side of an electric fireless. I spent some two hours in the process and then it did not cream. These slow devices have led the housewife to believe that electricity is by nature slow. I believe that the stove with the higher voltage, properly managed, will cost very little more to operate and will be far more useful to the housekeeper. The insulation of the oven should



The Arrangement of Stove Space for Electric Cooking

be sufficient to store heat, and I am quite convinced that the coil in the bottom of the oven should carry more wattage than the upper element. I see no reason why a fireless cooker compartment should not replace one plate in a four-burner stove.

One fairly large compartment would be sufficient for the average family, and would be a convenience in addition to saving current. A small disc would be a saving for making coffee and cooking in a small quantity. The cooking utensils in use are not designed for electric cooking. All utensils to be used on an electric plate should have straight sides, flat bottoms and should be slightly larger in diameter than the plate and should have a tight fitting lid. It is possible with the new type of electric range to work out very definite instructions for cooking.

Formerly we gave proportions for a cake and directions for mixing, but we could only say, bake in a slow, medium, or quick oven. True, we had a few

tests, if flour or paper browned in five minutes, the oven was ready for bread, but experience has been the only real teacher in handling a coal or gas range.

We shall welcome a cook book that will give definite directions for all oven work, and I am sure that it would be a very great advantage in selling such stoves as are being made now.

Directions for operating the oven to properly bake a sunshine cake on a Hughes stove might read like this:

> Put a paper cap over the pan and place in the center of the oven. Turn both elements on full for five minutes. Reduce upper element to low. Reduce lower element to medium for ten minutes. Then hold both elements to low for fifty minutes longer. The cost of baking as per instructions at 3c per kw.-hr. is .0217.

Directions for roast beef, medium well done would run something like this:

> Remove the baffle pan. Turn both elements on full. Sear the roast well under the upper element. When the oven reaches 250 deg. place the roast on the lower lift and leave current on full until the temperature of the oven starts to increase. Reduce to low, hold at this temperature, allowing 20 to 25 minutes to the pound. A five-pound roast would cost in the Hughes oven something like 10c to bake.

In electric ovens better results in the cooking of meat are obtained by using less current and increasing the time of cooking. The higher temperature results in a greater shrinkage and a poorer finished product.

The greatest cost will always come in pre-heating an oven to the desired temperature. The careful housekeeper, if she is cooking a roast, will plan an oven dinner.

Very definite instructions could be worked out for using the plates also. The housekeeper has so long been used to fuel that could not be handled scientifically that it is going to take some education to induce her to use it properly. She will have to remember the boiling point is 212 deg. and that no matter how much current you use under ordinary conditions you will not be able to cook any faster, and will only waste electricity.

There are many electric appliances which will materially aid the housekeeper. A motor attachment for an egg-beater, an ice-cream freezer, and a bread mixer should be very practical. A breakfast table equipped with a percolator, a toaster, and a grill certainly helps solve the problem of doing without a maid.

It seems to me that the manufacturers of electric appliances should consider this Western country one of their big fields. Almost every farm may have its own power plant and the smaller towns have no gas plants, so that the electric stove has no competitor outside the cities.

When the central stations will sell us current for 2c per kw.-hr. and the factories will give us a practical range for $50, the electric range will be without a competitor.

Due to the efforts of the Portland Railway, Light & Power Company, the girls' department of the Benson Polytechnic School was given three electric ranges and a number of plates, and my observations on the cost of electric cooking are based on experiments conducted on these ranges.

Charts similar to the one below were worked out for each range and the plates. It has been comparatively easy to compute the actual cost of fuel from these charts.

Dinner I Hughes

Boiled Chops — Baked Potatoes
Buttered Asparagus — Hot Rolls
Egg Salad
Strawberry Short Cake — Coffee

		Time.	Cost.
Upper Oven	Full	30 min.	$ .0192
	Medium		.0051
	Low	28 min.	
Lower Oven	Full	42 min.	.0200
	Medium		.0018
	Low	13 min.	
Plate I	Full	28 min.	.0172
	Medium		
	Low	18 min.	.0026
Plate III	Full	15 min.	.0086
	Medium		
	Low	20 min.	.0035
			$ .0780

Chops, potatoes, rolls and short cake were done in the oven; eggs, asparagus and coffee on the plates.
This dinner was served to six people.

Dinner II Hughes

Swiss Steak — Mashed Potatoes
Spinach — Bread and Butter
Pear Salad
Tapioca Cream — Coffee

		Time.	Cost.
Plate I	Full	36 min.	$ .0205
	Medium		
	Low	27 min.	.0039
Plate II	Full	21 min.	.0120
	Medium		
	Low	9 min.	.0016
Plate III	Full	17 min.	.0097
	Medium		
	Low	11 min.	.0017
Plate IV	Full	10 min.	.0094
	Medium		
	Low	25 min.	.0062
			$ .0650

The oven was not used in cooking this meal.
Tapioca cream was made in double boiler.
Seven people were served.

Cost of Operating Hughes Range for the Following Stated Periods at the Rate of .03 per Kw.-hr
Hughes No. 50 (Only).

		Watt hrs.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	55 min.	1 hr.
Broiler—	High	1300	.0032	.0064	.0096	.0128	.0160	.0192	.0224	.0256	.0288	.0320	.0352	.035
"	Medium	700	.0017	.0034	.0051	.0068	.0085	.0102	.0119	.0136	.0153	.0170	.0187	.021
"	Low	350	.0008	.0017	.0025	.0034	.0042	.0051	.0059	.0068	.0076	.0085	.0093	.0105
Oven—	High	1000	.0025	.0050	.0075	.0100	.0125	.0150	.0175	.0200	.0225	.0250	.0275	.03
"	Medium	500	.0012	.0025	.0037	.0050	.0062	.0075	.0087	.0100	.0112	.0125	.0137	.015
"	Low	250	.00062	.0012	.0018	.0025	.0031	.0037	.0043	.0050	.0056	.0062	.0068	.0075
No. 1. Element—	High	1150	.00287	.0057	.0086	.0114	.0143	.0172	.0200	.0229	.0258	.0287	.0315	.0345
"	Medium	550	.0013	.0027	.0039	.0052	.0065	.0078	.0091	.0104	.0117	.0130	.0143	.0165
"	Low	300	.00075	.0015	.0022	.0030	.0037	.0045	.0052	.0060	.0067	.0075	.0082	.009
No. 2. Element—	High	1150	.0028	.0057	.0086	.0114	.0143	.0172	.0196	.0229	.0258	.0287	.0315	.0345
"	Medium	550	.0013	.0026	.0040	.0054	.0068	.0082	.0095	.0107	.0123	.0137	.0150	.0165
"	Low	300	.00075	.0015	.0022	.0030	.0037	.0045	.0052	.0060	.0067	.0075	.0082	.009
No. 3. Element—	High	1150	.0028	.0057	.0086	.0114	.0143	.0172	.0196	.0229	.0258	.0287	.0315	.0345
"	Medium	700	.00175	.0035	.0052	.0070	.0087	.0105	.0122	.0140	.0157	.0175	.0192	.021
"	Low	350	.00087	.0017	.0026	.0035	.0043	.0052	.0061	.0070	.0078	.0087	.0096	.0105
No. 4. Element—	High	1900	.0047	.0094	.0141	.0188	.0235	.0282	.0329	.0376	.0423	.0470	.0517	.057
"	Medium	950	.0023	.0047	.0070	.0094	.0117	.0141	.0164	.0188	.0211	.0235	.0258	.0285
"	Low	500	.0012	.0025	.0037	.0050	.0062	.0075	.0087	.0100	.0112	.0125	.0137	.015

Breakfast I. Hughes.

Oranges.
Muffins. Cuddled Eggs.
Jelly. Coffee.

		Time.	Cost.
Upper Oven	Full	27 min.	$ .0141
	Medium	5 min.	.0017
	Low	11 min.	.0018
Lower Oven	Full	27 min.	.0135
	Medium		
	Low	11 min.	.0013
Plate III	Full	15 min.	.0086
	Medium		
	Low	15 min.	.0026
			$ .0436

The muffins and eggs were done in the oven. This breakfast was served to five people.

Breakfast II. Hughes.

Corn Flakes. Sliced Bananas.
Toast. Jelly.
Coffee.

		Time.	Cost.
Upper Oven	Full	12 min.	$ .0077
Plate III	Full	22 min.	.0126
	Low	5 min.	.00087
			$ .02117

This breakfast was served to five people.
The percolator is a six-cup universal with a very small disc bottom.

Breakfast III.

Stewed Apricots.
Cream of Wheat, Sugar, Cream.
Griddle Cakes, Syrup.
Coffee.

		Time.		Cost.
Plate I	Full	5 min.	Apricots	$ .00287
	Low	15 min.		.00220
Plate I	Full	9 min.	Cereal	.00570
	Low	2 min.		.00015
Plate II	Full	20 min.	Coffee	.01140
	Low	13 min.		.00180
Plate II	Full	10 min.	Syrup	.00570
	Low	5 min.		.00075
Plate IV	Full	10 min.	Cakes	.00940
	Low	13 min.		.00370
				.04367

This breakfast was served to five people. At least twelve griddles of cakes were cooked. After the griddle was thoroughly heated, the cakes could have been cooked indefinitely on low.

Sunshine Cake.

		Time.	Cost.
Upper Oven	Low	9 min.	
	Medium		$ .00576
	Full		
Lower Oven	Low	22 min.	.00274
	Medium	31 min.	.00774
	Full	9 min.	.0045
			$ .02074

Ten eggs were used in this cake.

Angel Cake.

		Time.	Cost.
Upper Oven	Low	50 min.	$ .0085
	Medium		
	Full	5 min.	.0032
Lower Oven	Low	40 min.	.005
	Medium	10 min.	.0025
	Full	5 min.	.0025
			$ .0217

This cake was baked in an aluminum pan with tube center. Twelve eggs were used.

TEN BILLION TONS OF COAL

The Nenana coal field, Alaska, will be tributary to the government railroad now under construction from Seward to Fairbanks. Though the coal of this field is lignite and hence of low grade, yet it has great value as a source of fuel and power for Fairbanks and other Yukon placer camps. The field is about 60 miles south of Fairbanks. It is estimated by the United States Geological Survey, Department of the Interior, that the Nenana field contains some ten billion tons of lignite. The Nenana coal field lies in what is known as the Bonnifield region, which also contains some gold placers that have been mined in a small way for the last 10 years. This district is described in a report entitled "The Bonnifield Region, Alaska" (Bulletin 501), which can be obtained on application to the Director of Geological Survey, Washington, D. C.

OZONE FOR THE CHILDREN—II. OR ENGINEERING TWISTERS RETOLD

I then recalled to the group interested in the discussion how the clever young wire-stringer out West was said to have made a princely salary in drawing copper for one of the large hydroelectric companies. This young man proposed to the head of a construction gang that he needed work and he must have it at any sacrifice. In fact, money he said was of small consequence. He must have something whereby he could acquire sufficient to eat and at the same time amass experience in his chosen profession. He would gladly sign up for a year while getting his experience, and in fact would agree that one dollar for the first month, in addition to his meals, would be sufficient. As the months passed by during the year, he said his experience would make him a valuable man. As a consequence it would seem that doubling his cash allowance each month for the year ought to offset his increased usefulness due to the experience acquired. The chief quickly computing for several months ahead the small salary item, readily agreed, but at the conclusion of the year he fainted when he found this mean salaried youth drew down $4095 in addition to his board bill, as follows:

1st month..	$1.00	5th month.	$ 16.00	9th month.	$ 256.00
2d " ..	2.00	6th " ..	32.00	10th " ..	512.00
3d " ..	4.00	7th " ..	64.00	11th " ..	1024.00
4th " ..	8.00	8th " ..	128.00	12th " ..	2048.00
					$4095.00

AN EXAMPLE IN CONSTANT ANGLE DESIGN

(continued from page 112)

a slight curvature sufficient to take care of the horizontal tension.

Whenever load is supported on a beam or on a cantilever, shearing stresses are introduced. These shearing stresses reach their maximum values at the foundation and at the abutments, and should be investigated in order to be sure that they are within safe limits. In the case of dam section shown in Fig. 3, base 70 ft., it can easily be shown that even should the shear on the lower 50 ft. of the dam correspond to the full water pressure, this stress would be entirely within the safe limits, amounting to approximately 4,000 lb. per sq. ft. Along this joint the maximum unit compression generally exists. This compression is so much larger than the shear that actual shear cannot take place, as friction alone will prevent any tendency of sliding at the abutments.

Before concluding the general discussion the action of changes in temperature should be considered. As the ends of the arch are fixed to the abutments, the shortening or lengthening of the arch due to temperature changes either causes cracks to develop or forces the crown back and forth. In the constant angle arch type the average crown deflection for the same amount of decrease or increase in length of arch is only about one-half of that required by the common arch curve. (See curve **A** and **B**, Fig. 6), and the tension or compression necessary to cause this deflection or pulling back of cantilever may therefore not exceed the ultimate strength of the concrete, in which case no cracks would develop. In any event cracks are not so liable to occur as in the common arch type of dam.

MERCHANDISING ELECTRICAL ENERGY

(The oil engine, due to its widely heralded progress upon ship-going vessels, has created a new factor of competition in the merchandizing of electrical energy in the West. Whether this type of engine will ever attain the high type of usefulness claimed by its proponents time alone can tell. Here are arguments presented by the commercial agent of the Southern Sierras Company at Riverside in meeting competition from this source of inroad into the electrical field of distribution.—The Editor.)

COMPETITION WITH THE OIL ENGINE

BY R. REMSCHEL

In making a comparison on the cost of operation between the oil engine and electric motor the following are the items to consider:

Fixed Charges: Consisting of interest on the investment, depreciation. taxes and insurance. **Interest:** This is an arbitrary quantity and is usually figured at 7 per cent. However, there is no reason why it should not be figured higher and figured to its full earning capacity. **Depreciation:** Due to the fact that oil engines have not been in operation long enough to definitely determine, this has to be assumed. With the old type of gas engine figures usually used varied from 8 to 12 per cent, depending upon the care the machinery was likely to obtain. Due to the high temperature and speed that the oil engines operate under, it is reasonable to assume, and in fact, certain, that the life of the oil engine will be less than of its prototype, the gas engine, and therefore the figure of 10 per cent depreciation is not too high. With motors 5 per cent for depreciation is usually used and is ample, and as proof we can point to a number of motors that have been operating now for over 30 years and many of them are practically as good today as when they were installed. **Taxes:** This is the same in both cases, and is usually figured from 2 to 3 per cent, and 2½ per cent are the figures that are mostly used. **Insurance:** Due to the greater risk on account of the inflammable oils around the engine, insurance is usually a great deal higher than for motors, and runs approximately as follows: Gas and oil engines, 2 per cent; motors, 1 per cent. **Labor:** The amount of labor required varies with the type and size of engine; four cycles require more attention than two cycles. However, all of them should have constant attention. The engine salesman will tell you that this is not necessary. This, however, is not so, as there are many small and delicate parts about an engine, and if any of them should give trouble it would affect the whole engine. With a motor it is entirely different. These, as you might say, are "fool proof." A motor will run from one end of the year to the other with little or no attention. All that is required is oiling about once or twice a season. A small plant operating during the daylight hours with only one man as an attendant is usually sufficient. This attendant usually obtains from $75 to $100 per month as salary. Where twenty-four hours or continuous operation is required, sometimes one man can take care of the plant by sleeping in the engine room. This man usually obtains from $100 to $125 per month. This feature, however, is not a good one and not advisable, and the best policy is to employ two men, say one at $75 and the other at $60 per month. In case of electric motor no labor is required.

Repairs: This is another item which is difficult to predetermine, inasmuch as cost of repairs is in a great measure dependent upon the man in charge. Oil engines have not been in operation long enough to demonstrate and give authentic figures of the cost of repairs. However, it is reasonable to assume that it will be as much and more, in fact, than the present gas engine, which we find will easily exceed 5 per cent. Motors we know will not take that much, but to be on the safe side we will say also 5 per cent. This permits the motor being rewound every four or five years, thereby making it just as good as new again.

Fuel Oil: Oil engine manufacturers will guarantee from 10 to 15 h.p. hours per gallon of fuel oil; this, of course, at full load. With the proper adjustment on the engine a certain grade of fuel oil, for instance, oil that has a limited amount of water, a limited amount of sulphur and no ash, which is not always easy to obtain. In actual practice it has been demonstrated that the fuel consumption is usually a great deal higher. Then again, there is absolutely no guarantee as to how high the price of fuel oil is going to advance. All of our figures are based upon ten-year basis, and fuel oil can go skyhigh in that time. Look at the enormous advance of oil in the last ten years. There is nothing to assure us that oil will not continue to go up in the same proportion in the future. With electricity you are absolutely assured to get it. You can make a contract with the power company for any number of years in advance, thereby assuring yourself against a rise in rate.

Lubricating Oil: Due to the high speed and temperature that oil engines operate under, they require a great deal of lubricating oil, and the cost is usually about 15 per cent of the cost of fuel oil; that is, providing that the engineer looking after engine is very careful. I have known of instances where the fuel oil cost on a stationary engine was over 50 per cent of the cost of the fuel oil, and in one instance that was brought to my attention in the case of a marine engine the cost of lubricating oil exceeded that of the cost of the fuel oil. This only demonstrates that it is up to the man in charge, while with the motor the lubrication is automatic and cost of lubricating oil is never figured, as it is a negligible quantity, and $1.00 worth of oil will take care of the average sized motor for over a year.

Arguments Against the Oil Engine: Some of the arguments against an oil engine, or, in fact, any engine, are that the cost of operation cannot really be determined with any degree of accuracy. The person purchasing an oil engine can be compared to a person

sitting down to a game of poker—neither one of them can tell what is in store for them. There are a great many things which depend upon the successful operation of the engine. **The Labor Question:** While you might have excellent help today, you are not sure how long you are able to retain them. Then the proper mixture of fuel is necessary, which again depends upon the great number of changeable conditions. Then we have the necessity of proper lubrication; if not enough oil is given trouble will occur; if too much, the cost of operation is too high, and it really takes an expert to really determine exactly how much is required under the different operating conditions. Then you have the cost of fuel oil; this is steadily rising in price from year to year and no one knows when it is going to stop. You look back a few years and see how the price has gone up.

One thing in making comparison that is usually overlooked and which is quite an item, although on the face of it does not seem so, is the belt question. Take two similar cases—one is with a motor and the other with an oil engine, and you will find that the motor driven belt will last at least twice as long as the one on the engine. This is due to the fact that with a motor the pull is absolutely steady and the leather does not have to work, while in the case of the engine the impulses produced by the combustion are all transmitted through the belt and very soon wears it out. Belts at the best do not last long, and, furthermore, they are expensive.

Oil installations, due to their size, require a great deal larger building and more ground, which means additional investment. Then, again, the best of oil engines leak oil and keep the surroundings in a dirty looking condition, and a great deal of time is spent in cleaning up. Then there is the noise of the exhaust, which perhaps in the daytime is not so objectionable, due to the surrounding noises, but at night, when one wants to sleep, there is no question but that it is a nuisance.

One item that is usually overlooked is that in order to obtain at the lowest possible price it is necessary to purchase oil in carload lots. This means that provision for storage has to be made for at least a carload and a quarter. This entails an additional investment, rapid deterioration of the tank and considerable loss in evaporation of the oil. Also interest on the money tied up in laying in a large supply of oil must be allowed. All these items, taken individually, do not amount to so very much, but collectively they do and should be figured.

While our figures are all on a ten-year basis of depreciation, in all probability long before that time is up these engines will have been superseded by some more modern machine and the depreciation charge in that way increases from what it was originally figured.

In conclusion I want to say that if the salesman who gets into competition with oil engines will bear in mind that they are new and have not been tried thoroughly and to see what results they will obtain in the long run and of course upon the prospects that at best everything pertaining to the oil or gas engine is nothing but guess work. This point should be brought out very strongly to the prospect. The salesman should acquaint himself thoroughly with the other fellow's proposition and try and know a little more about his business than he does himself so that he can combat any erroneous statements his competitor is liable to make.

Example.

It is intended to install a plant that will require 20 h.p. but 25 h.p. is to be installed, will operate seven months continually, electricity is $42.00 per h.p. and distillate $1.50 per barrel, lubricating oil 50c per gallon.

Electricity.

First Cost—	
1-25 h.p. motor, 1200 r.p.m.	$ 380.00
Wiring	85.00
Foundation	15.00
Belt	60.00
Total	$ 540.00
Fixed Charges—	
Interest, 7 per cent.	
Depreciation, 5 per cent.	
Taxes, 2 per cent.	
Insurance, 1 per cent.	
Total, 15 per cent on $540.00, equals	$ 81.00
Repairs—	
5 per cent on $540.00 equals	27.00
Labor—	
1 hour per day at 25c, equals per month, $7.50.... 8 months, 60.00....	60.00
Electricity—	
20 h.p. at $42.00 per h.p.	840.00
Lubricating Oil—	
2 gallons at 50c, equals	1.00

Oil Engine.

First Cost—	
1-25 h.p. engine	$1,000.00
1 Fuel tank	250.00
Installation	50.00
Foundation	75.00
Belt	80.00
Total	$1,455.00
Fixed Charges—	
Interest, 7 per cent.	
Depreciation, 10 per cent.	
Taxes, 2 per cent.	
Insurance, 2 per cent.	
Total—21 per cent.	
21 per cent of $1455.00 equals	$ 305.55
Repairs—	
5 per cent of $1455.00 equals	72.75
Labor—	
1 man, $60.00 per month, equals	420.00
Fuel Oil—	
On basis of 10 h.p. hours per gallon is two gallons per hour, 1460 gallons per month or 10,220 gallons for seven months, equals 243 barrels at $1.50 per barrel equals	364.50
Lubricating Oil—	
This will require 2 barrels in 7 months, at $21.00 per barrel, equals	42.00

Summary.	Motor.	Oil Engine.
Fixed Charges	$ 81.00	$ 305.55
Repairs	27.00	72.75
Labor	60.00	420.00
Electricity	840.00	
Fuel Oil		364.50
Lubricating Oil	1.00	42.00
Total	$1.009.00	$1,204.80

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Worthless lands, long discarded due to over saturation of alkali salts, are now to receive the revitalizing attention of the electrically operated pump. In the following article recent drainage activities around Fresno, California, are considered and the fruits of recent experiments there performed should assist much in extending the usefulness of the electrically operated pump to other sections of the West where drainage for alkali saturation is feasible.—The Editor.)

POSSIBILITIES OF PUMPING FOR DRAINAGE

The need of drainage for a large area of land near Fresno has been recognized for many years and the methods by which such work could be accomplished have been the subject of investigation by both private and public organizations. Two reports have been issued recently in which this subject is discussed. One of these is the report of Mr. L. C. Hill, consulting engineer, prepared for the Director of the U. S. Reclamation Service; the other is Bulletin 273 of the California Agricultural Experiment Station on the "Kearney Vineyard Experimental Drain" by W. W. Weir. The following discussion has been prepared from the information given in these two reports.

Report of Mr. Hill

The report of Mr. Hill covers the more complete utilization of the waters of King's River by the storage at the Pine Flat site of 600,000 acre feet of flood water and the development of 300,000 acre feet annually by pumping from ground water in the areas now irrigated. As stated by Mr. Hill, "In order to utilize the flow of Kings River to the utmost and to bring the largest amount of land in cultivation in this district, it is necessary (1) to build a storage reservoir of as large capacity as topographical conditions make feasible at reasonable expense; (2) to supplement this supply by that from the underground storage reservoir in the delta of Kings River, of which the available capacity, with a comparatively small fluctuation of the underground water plane, is probably from three to four times that of the reservoir to be built at Pine Flat."

It is estimated that of the water placed upon the land probably twenty-five per cent passes down below the plant roots and is lost so far as surface use is concerned. Including canal and river bed seepage it is considered reasonable to suppose that 500,000 acre feet per year may be pumped from the underground waters in the delta of Kings River without permanently lowering the water plane. If pumping is limited to 200,000 acres with an annual lowering of the water table of 10 ft. and a ground water storage equivalent to 20 per cent of the volume, 400,000 acre feet per year could be developed. In the calculations as to the future supply of the district Mr. Hill assumed that 300,000 acre feet could be safely pumped each year from underground storage. The small slope of the land in this area makes the cost of gravity outlets too high to be considered feasible.

To supplement direct flow and storage supplies it is estimated that 63,000 acre feet will be required from such pumping in the month of maximum demand. This is equivalent to a mean discharge of 1050 second feet for this month. Adding 15 per cent for reserve pumping plants to cover breakdowns and for use in times of shortage in the gravity supply, a total of 605 plants developing 2 second feet each are considered desirable. Pumping drainage water from sumps about 10 ft. deep into irrigation ditches, it is stated, has been in practical operation here for some years. The topography of this district is such as to make the cost of a gravity outlet, at least for small districts, prohibitive. Tile drains discharge their water into shallow wells or sumps from which it is raised into the irrigation ditches. It is estimated from data obtained from wells operating here that an average of 2 second feet can be obtained from each well with average lifts, including draw down of not over 30 ft. On an estimated overall efficiency of 45 per cent each plant will require a 15 horsepower motor or a total power development requirement at the dam of 10,500 kw.

The following estimated cost was used for such pumping plants:

Motor	$315
Pump	660
Foundation	20
Wiring, etc.	35
Derrick	50
Well	1275
Pump house	150
Transformers	150
Total	$2655
Engineering and contingencies	345
	$3000

The cost was considered to be practically the same whether belted or direct connected units were installed. The direct connected unit would operate at a higher efficiency and in many ways be more satisfactory. The estimate given is based on the deep well turbine type of pumps, although the cost of the complete pumping plant would not greatly differ whatever type of pump might be adopted.

This cost is at the rate of $1500 per second foot capacity. The total cost of the 605 plants would be $1,815,000. If run continuously for 180 days, 435,600 acre feet would be pumped giving a plant cost of about $4.17 per acre foot of capacity as against an estimated cost of $11.61 per acre foot for storage.

Such pumping from the ground water would not only furnish a supplemental water supply for the irrigation of additional lands but would also lower the ground water on lands now rendered infertile by the high water table and the accumulation of alkali.

Experimental Drain of Kearney Vineyard

This report gives a detailed account of an experimental drainage system actually in operation on a portion of the lands of the Kearney Vineyard property now owned by the University of California. While various general investigations of the need for and

methods of drainage in this vicinity have been made by different government bureaus, it was felt that none of these had been carried far enough to demonstrate the actual results obtainable and the costs of such work. An area of 160 acres previously productive but which in 1912 had become badly "alkali" was selected for the experiment. The alkali in the surface foot varied from less than 0.2 per cent over most of the tract to 30 per cent over small areas. The principal salts were sodium chloride and sodium carbonate, the former predominating. The water table varied from within 2 ft. of the surface in June to a maximum depth of 7½ ft. in the early winter.

The system consists of covered tile drains leading to a sump from which the water is pumped. The average depth of the main drain is 7 ft. and that of the laterals 5¾ ft.

In the system as constructed in 1913 a 3½ inch vertical centrifugal pump direct connected to a 5 h.p. motor was used. Soon after flooding to remove the alkali was begun in 1914, it became apparent that the discharge of the drains could not be handled by this plant. An auxiliary pump operated by a gasoline engine was temporarily installed at one of the silt wells on the main drain; at the end of the 1914 season this equipment was replaced by a 5 inch horizontal pump direct connected to a 7½ h.p. motor. It was necessary also to relay a portion of the main drain with larger sized tile. In 1914 after flooding, one-half the tract was planted to Egyptian corn; the stand secured, however, probably did not more than pay for the cost of harvesting. In 1915 no crops were grown, the season being devoted to the eradication of Bermuda grass which had become established on the area. The plowing, collecting and burning of this grass, repeated as required, cost $12.20 per acre. In 1916 oats and barley were grown on the whole tract, the average yield of hay being 1.2 tons per acre.

In 1914, flooding of the tract to remove alkali continued throughout March and April, as much as 40 acres being under water at one time. Sufficient water to cover the tract to a depth of 1.88 ft. was removed by the drains during this year. In 1915 the larger pump removed water equivalent to an average depth of 2.79 ft. over the tract; in 1916 the corresponding figure was 3.12 ft. In 1915 the pump was in operation 97 per cent of the time between March 22 and August 20, the average discharge from the 160 acres being 1.52 second feet. In 1916 the pump operated 97 per cent of the time between April 10 and September 25, the average rate of discharge being the same as in 1915. In 1915, the maximum weekly discharge occurred in April and was at the rate of 2.38 cubic feet per second.

Owing to the effect of the flooding it is difficult to determine the amount of lowering of the ground water due to the drains. In May, 1916, the average depth to ground water on the tract was 4.8 ft. when the depth in 3 wells on the tract south of the one drained was 2.6 ft.

The results of alkali tests carried on during these years indicates that a total of 285 tons of alkali salts have been removed from the 160 acres with the drainage water. In 1914, it was found that the average alkali in the surface foot had been reduced to 50 per cent of that present before draining; in 1915, the alkali was further reduced to 40 per cent of the original amount. Over ¾ of the sodium chloride was removed and about 1/6 of the sodium carbonate. The average alkali content is now less than is usually considered detrimental to crops.

The cost of this work has been higher than would be necessary with other similar work. In addition to the direct changes actually made, experience on this tract has shown places in which costs could be reduced. The cost up to January, 1916, had reached a total of $100 per acre. The cost of the original construction was $60 per acre of which the cost of the 21,840 feet of 6 to 12 inch tile was about $42 per acre or an average of 29 cents per foot of drain. The cost of the field ditch system and checks for flooding was $6.35 per acre. The expenses in 1914 amounted to $18.60 per acre of which $9.50 consisted of changes in construction, $7.10 in operation, including the cost of flooding and $2.00 in Bermuda grass control. In 1915, $4.00 per acre were spent in flooding and operation of the system and $12.20 per acre in Bermuda grass control. Beginning with 1916, the tract was considered to be sufficiently productive to be self-supporting. Of the total costs of $100 per acre, $20 were expended on the land in flooding and Bermuda grass control which in many tracts may not be necessary. It is estimated by Mr. Weir that $20 per acre of the construction cost could be served in future systems. On this basis such drainage plants under favorable conditions might reclaim lands at a cost of $60 per acre.

Mr. Weir recommends that drainage plants under similar conditions be designed to remove 1 second foot for each 100 acres drained and that lateral drains be placed about 400 ft. apart and 6½ to 7 ft. deep.

Comparison of the Two Methods of Drainage.

These two reports involve the use of pumping as a means of lowering the ground water. In the tract on the Kearney vineyard the water is brought to the sump through covered tile drains, a method which the author estimates may be constructed at a cost of $60 per acre, although the actual cost on the experimental tract was $100 per acre. The records of the drainage work in other systems indicates that the cost for large areas might be reduced materially below $60 per acre due to the use of equipment which such work would make practical. Mr. Hill's method, based on plans which have been advocated for a number of years by Mr. I. Teilman, engineer of the Fresno Canal & Irrigation Company, consists in drawing the ground water to greater depths (estimated to average not over 30 ft.) at the pumps so that the system of tile drains will not be required.

Mr. Hill's estimated cost of $3000 per pumping plant of 2 second feet capacity would be equivalent to a cost of $15 per acre if 200 acres per pumping plant were drained, this being the rate of capacity recommended by Mr. Weir. Mr. Hill as a preliminary figure estimates that the 605 plants can draw from 200,000 acres or an average of 330 acres per plant which is equivalent to $9 per acre drained. The tile drainage method requires a lift of only 12 or 14 ft. or less than one-half the average lift in the proposed sump method.

PACIFIC COAST N. E. L. A. SECTION JOTTINGS

(New Mexico and its central station problems have long been unheralded in other commonwealths of the West, although many new ideas of intense interest to other company members of the Pacific Coast N. E. L. A. Sections, are being worked out most efficiently. At a later date our readers will be given some of these ideas in more detail. In the succeeding pages brief notations from New Mexico are given, followed by a discussion on The Field Agent by the commercial engineer of the Southern Sierras Power Company. Contributions from all member companies are invited in these columns.—The Editor.)

NEWS OF MEMBER COMPANIES

The Deming Ice & Electric Company of Deming, New Mexico, in common with many towns along the Mexican border, has built up a profitable load among the military camps which have been established. The company made the pole line extensions and the army wires the tents. Due to financial difficulties of a large irrigation project in the vicinity, Mr. J. A. Shepard, the manager, has a large stock of vertical motors which he is gradually selling throughout the country. There does not seem to be much incentive for selling ranges here as the cold winters necessitate coal ranges for cooking and heating and consequently the summer cooking peak would be added to the summer irrigation load.

The Silver City Power Company of Silver City, New Mexico, records meter readings on a standard card showing the meter dials and ties a duplicate card to each meter which is also marked by the meter-reader. The consumer is requested to check this each month and report any errors found. M. R. Buchanan, manager of the company, has installed hot plates in the normal school and is starting a range campaign by installing ranges free on trial in the homes of selected consumers. A new 250 h.p. Snow oil engine is being installed to care for the recent increase in load in this prosperous little town. The operation of a raw water ice plant gives a large load in the summer. Power is also supplied to a 5-ton ice plant in one of the sanitariums for consumptives for which this town is famous.

CHANGES IN PERSONNEL OF PACIFIC SECTION N. E. L. A. COMMITTEES

President R. H. Ballard announces the following additions and changes in the personnel of the Pacific Coast Section Committees of the National Electric Light Association:

J. G. Scrugham of the University of Nevada, a new appointee on the engineering committee; A. E. Holloway of the San Diego Consolidated Gas & Electric Company appointed to the commercial committee in place of L. H. Newbert, resigned; H. A. Lemmon of the Truckee River General Electric Company, Reno, Nevada, and H. V. Aller of the Pacific Gas & Electric Company, Phoenix, Arizona, are added to this committee. At his own request W. E. Houghton of the Los Angeles Gas & Electric Corporation has been relieved of the chairmanship of the accounting committee on account of pressure of work. B. T. Story of the Southern California Edison Company is appointed chairman in his stead. M. H. Bridges of the Pacific Gas & Electric Company resigns in favor of W. J. Driscoll of the Pacific Gas & Electric Company, San Francisco. W. W. Briggs of the Great Western Power Company is appointed chairman of the membership committee of probably more than thirty members to be selected by him scattered throughout the territory. The personnel of this committee will be announced later.

The invitations of The Southern Sierras Power Company and the Riverside Chamber of Commerce have been accepted, and President Ballard states that the first annual meeting of the section will be held at Riverside the latter part of April, the 19th and 20th having been suggested, but not definitely settled upon. A. B. West, vice-president and general manager of The Southern Sierras Power Company, Riverside, has been appointed chairman of the committee on arrangements for this annual meeting.

Secretary Halloran has been in Arizona and New Mexico for the past six weeks in the interests of the section and has enrolled a large number of new Class A and Class B members from these states, with encouraging prospects for additional members in the very near future.

As the official representative of the Pacific Coast Section, Mr. Halloran will address the convention of the New Mexico Electrical Association, to be held at Albuquerque this month, and, among other things, urge the affiliation of that section with the geographic section.

No time has been lost by the committees in getting down to business, the members having taken hold of their work with energy and vim.

THE FIELD AGENT

BY ROSS B. MATEER

In the performance of his manifold duties the field agent uses such talents, as: personality, industry, initiative, perseverence, judgment, foresight and diplomacy. All contribute to the welfare of the copartnership of individual and utility and are to be fostered by the intelligent management that builds for the future not for the day only. An agent's individuality distinguishes him from the rank and file. By his activity he establishes an identity which should not be the object of attack by covetous centralized power and which seeks frequently to absorb all the personality of the employe in the interest of routine or mechanical efficiency. Cogs and pinions, brains working in a circle are a part of every organization, but are only kept in motion by the industry of the agent with a personality.

Laboriousness is frequently mistaken for industry. Overtime in many organizations is considered a qualification for promotion, and the blind following of the path blazed by the "Rules and Regulations" of a quasi Public Utility is confounded with loyalty by the department head who places so little confidence in his employes that every detail of a proposition must be referred to him for approval prior to presentation to the consumer. His slavery to his occupation and his unwillingness to confer authority on or give to associates jurisdiction over certain of his duties retards the growth of the business and nullifies the industry of the aggressive agent, who must await the sanction of his negotiations, while opportunity passes by.

The industrious agent is the one who uses his brain, who is resourceful and handles each proposition independent of the other, who persistently follows up each negotiation and choosing the psychological moment is rewarded with the game. Aggressiveness implies not only diligence and the elimination of all lost motion—but initiative, the main spring to success in the selling of one's services or a commodity.

The rut is easy traveling for the salesman without ambition. Censure is never his lot and frequently a dimensionless word of praise is accorded for the blind fidelity which sees only the walls of its prison, while the hustling agent full of energy, seeks new fields, and with the sincerity born of a knowledge of his faculties and of experience with electrical merchandizing, endeavors to occupy by extension of transmission line and the building of a distribution system that territory at present perhaps virgin but susceptible in his eyes of intensive development. Initiative has given the long transmission lines and patience has harnessed the turbulent mountain streams.

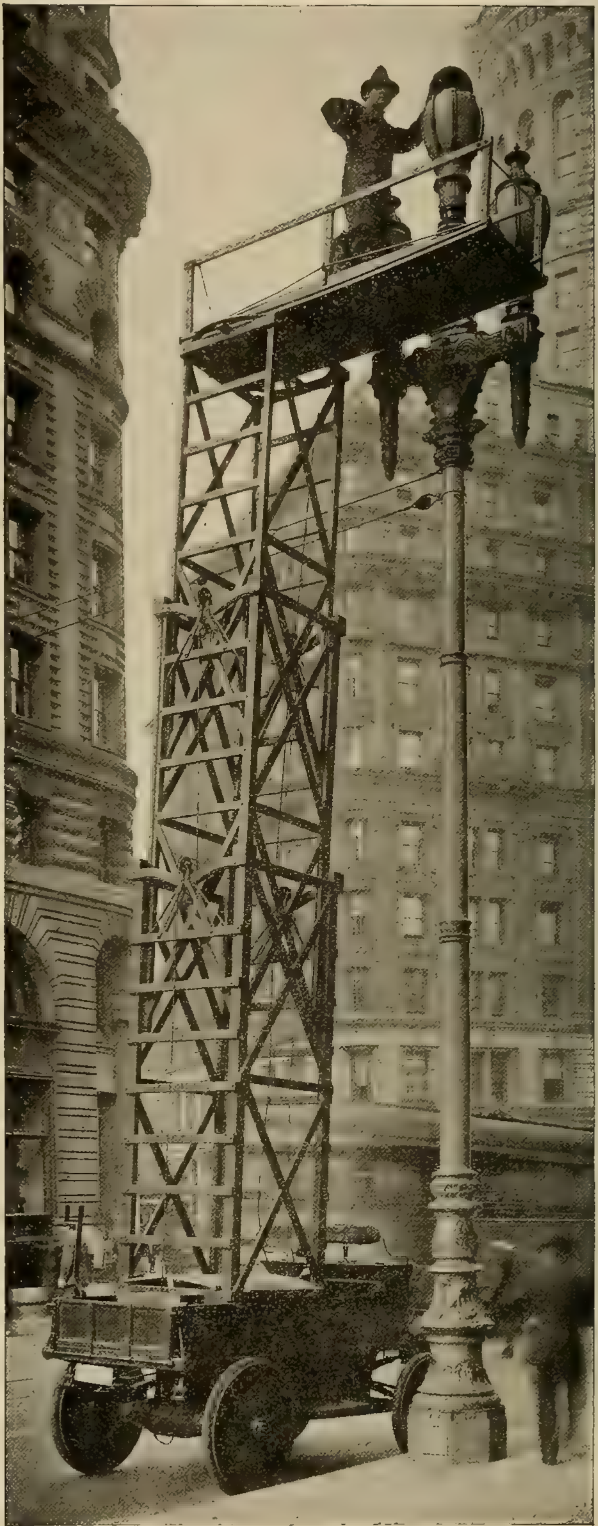
Intelligence has been accorded every man though only perhaps in proportion to his vocation, yet in all spheres of life the exercise of good sense is demanded and in none more than those immediately affecting the welfare and interest of the public. Affiliations of a political character and which shackle a utility must be broken. Funds ordinarily finding their way to the pockets of the clever labor organizer or to civil officials must be diverted to the legitimate channels of constructive effort and service improvement. Why not turn again to the field agent?

Momentus decisions must be given not in accordance to the literal interpretation of a rule but with regard to the facts presented and as the agent's conscience dictates even though the exercise of good sense or the tactful handling of a proposition, political or commercial, subject the representative to criticism. Revenue producing business must be sought and contracted with the thought that all rules and regulations are guides subservient to the judgment and the diplomacy of the "Live Wire" field agent whose courage is founded not alone on education for a chosen vocation, but upon the exercise of his talent and imagination.

Are your field men, your agents, accorded your cooperation? Do you wish slavish fidelity or do you seek men with personality? Do you seek increased revenues—then why not remunerate for the industry and the initiative of the man of calibre?

A NEW ARC TRIMMER'S TRUCK FOR THE PATH OF GOLD

The installation of the beautiful Path of Gold in San Francisco wherein art and utilitarianism are combined by making use of the tops of metal trolley poles for arc lamp installation has brought forth new ideas in facilities for trimming the arcs. Here is shown a creation of the Pacific Gas & Electric Company consisting of a trimmer's truck with three-lift platform, motor operated, that is proving useful and extremely efficient in caring for the splendid lighting effects of lower Market street in San Francisco.



Arc Trimmer's Truck, with Three-Lift Platform

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(The subject of demand charges has engaged the attention of engineers and rate fixing bodies of the country over. Here are some timely suggestions for the contractor and dealer devoted to a method of keeping down demand charges. An unusually timely discussion is also given on the subject of rectifying devices just issued by the California Industrial Accident Commission. The author is with the San Francisco office of the Western Electric Company in the capacity of power apparatus specialist.—The Editor.)

A METHOD OF LIMITING DEMAND CHARGES.

When electric service is purchased under a system of rates, which is based upon the total connected load, it is of course advantageous to the consumer to keep the load down to its lowest possible value. In many cases consumers may have several devices connected to the service through the same meter, but desire to use only one or part of them at one time, and never all at the same time. Under these circumstances, the consumers feel that the charges based on the connected load should apply only to the largest load which would actually be in use at one time, and not to the entire connected load.

Several of the electric companies on the Pacific Coast now supply certain classes of service on this basis. Under these conditions, the consumer's load is divided into groups, each consisting of one or more devices as desired and the various groups are con-

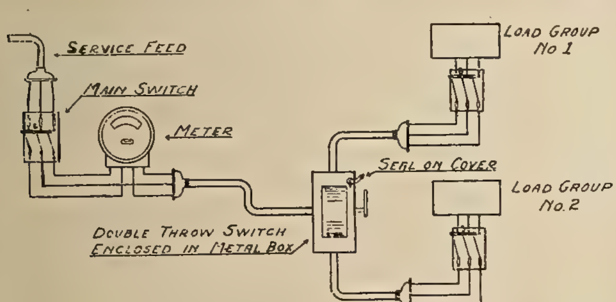


Fig. 1. Double Throw Switch for Two Load Groups

trolled by one or more double-throw switches so connected that only one of the load groups can be operated at any one time. The maximum load of the largest group is then taken as the actual connected load for the purpose of arriving at any charges that are dependent upon the connected load. The connected load so figured is used in determining monthly or annual minimum charges or in determining the schedule of kilowatt-hour rates provided the rate varies with the connected load.

Many of these switches have been used in connection with electric water heaters, cooking devices, ranges and for power service. Some companies will permit them for any of these loads, others will not, depending upon what rate schedule the consumer is purchasing his electric service. A general requirement seems to be that the load so subdivided must come under one rate classification. All switches and necessary wiring must be installed at the expense of the consumer, but remain under the supervision of the company.

The regulations of the different companies covering the use of such switches and the manner in which they must be installed are in a general way about as outlined in the following paragraph, which is copied verbatim from a book of service rules and regulations issued by a certain electric corporation on the coast:

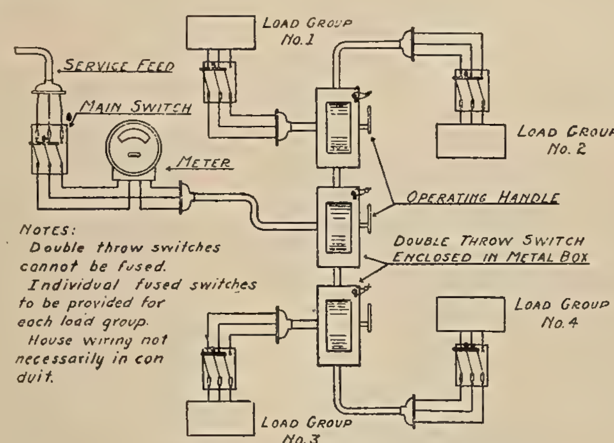


Fig. 2. Double Throw Switch for Four Load Croups

Double-throw switches or other approved demand limiting devices will be permitted to limit the demand which can be created at any time on the company's supply system through the operation of the consumer's electrical equipment.

Where the consumer desires to use more than one unit of electrical equipment not intended to operate simultaneously, and the maximum demand is controlled by means of a double-throw switch or other approved demand limiting device, the connected load will be taken as the maximum load which can be connected at one time to the company's system.

All demand limiting devices shall be installed by the consumer to the satisfaction of the company and all double-throw switches shall be enclosed in approved metal boxes, with only the operating lever on the outside of the box, and all wiring to and from said box shall be in metal conduit to the point of delivery on the exterior of the building, and the company shall seal said box with the company's seal, and no such seal shall be removed, tampered with, or broken, except by a representative of the company appointed for that purpose. Should the consumer or anyone on the consumer's behalf break said seal, or should the wiring be so connected as to bridge the switch, then the consumer in such event shall cease to have the right to use a double-throw switch in connection with the use of any electric energy furnished by the company.

As will be noted this particular company requires all wiring to be in conduit. Other companies are not quite so exact on this point, but are satisfied if the wiring complies with the National Electric Code or any other local regulations that may take precedence over the code.

The general scheme of connections is shown in the accompanying diagrams, Fig. 1 applying for two-

load groups controlled by a single switch and Fig. 2 showing four groups with three similar switches. In the later instance, the middle switch simply acts as a selector switch for the other two but only one of the load groups can be connected to the service at one time.

Any switch meeting the requirements herein stated will, of course, be satisfactory for this work. The type which has been most used is the line of switches especially developed for this service by the manufacturers of the well known "Square D" enclosed switches. These switches are sold by all of the leading jobbers.

To the best of the writer's knowledge no literature covering the particular switch used has been published. For the benefit of those likely to be interested the following description is given:

Mfg. No.	Volts.	Amperes.	Style.
52311	250	30	T.P.D.T.
52352	250	60	"
52353	250	100	"
52354	250	200	"

This article is intended to give the electrical contractor or others interested such information as would be required to make an intelligent estimate upon an installation of this kind and to answer a number of questions which have been brought up from time to time. Information on the question of rates or similar matters should be secured from the local electric company.

SIZE OF NEEDLE AND THREAD FOR MOTOR-DRIVEN SEWING MACHINES

To get the most satisfactory results from motor-driven sewing machines it is necessary to choose the right needle to carry the thread. On modern sewing machines this information is given on a metal plate placed in a prominent position. However, it seems that this is seldom followed and many women will not take the trouble to change the needle when putting on a coarser or finer thread. This causes frequent breaking of the thread. It is further essential that the thread should be of the best quality.

These precautions are necessary because of the high speed at which electric driven machines are ordinarily driven, and must be applied to old machines to which motors have been attached as well as to the new portable electric driven sewing machines which are now on the market.

Dealers who handle such equipment should call these points to the attention of each purchaser. By doing this they will eliminate many complaints.

NOTES ON INSTALLATION OF RECTIFYING DEVICES

In connection with the operation or installation of rectifying devices it is well to remember that the direct current end of such apparatus is most always electrically connected to the alternating supply circuit. This statement applies to all such devices as converters, mechanically driven commutators or rectifiers, chemical or electrolytic rectifiers and mercury arc or vacuum tube rectifiers, but, of course, not to motor-generator sets, since in these machines the direct and alternating current windings are insulated from each other.

From these facts it will be clear that the insulation of any apparatus connected to the direct current side of the device may under certain conditions be subjected to a potential much higher than normal and that such apparatus should be handled with the same precautions as would other apparatus connected directly to the alternating supply circuit.

This particular point is now fully covered by paragraph 2 of section (f) Order 700, Electrical Utilization Safety Orders which reads as follows:

> When one circuit is directly connected to another circuit of higher voltage (as in the case of an auto transformer), both are considered as of the higher voltage, unless the circuit of lower voltage is permanently grounded. Direct connection implies electrical connection as opposed to connection merely through eelctromagnetic or else electrostaic induction.

Many persons overlook these facts and are rather careless in dealing with such circuits, probably because in many instances, the direct-current apparatus is operated at lower voltage than the supply circuit.

Let us illustrate this point by an actual case. Take for example, a storage battery of eleven cells being charged through a rectifier which is supplied from one side of a 110-220 volt 3-wire, single-phase system. Assuming the neutral conductor of the system is grounded, as is customary, then a person touching any live part of the battery and at the same time being in contact with the ground would receive practically the full voltage between the neutral and one outside conductor or about 110 volts, although the difference of potential across the terminals of the battery would never exceed more than about 28 to 30 volts even while being charged.

Note also that should the battery become grounded a short circuit would result if the rectifiers were in operation. Therefore, when it is necessary or advisable to permanently ground the direct current circuit, an insulating transformer must be supplied to remove the ground from the alternating current side of the rectifier. Standard transformers for this purpose have the primary and secondary windings so arranged that either may be connected for 110 or 220 volts as is desired.

SEASON FOR FAN REPAIRS

February is the proper time to start a campaign for the repair or overhauling of fans which have been laid away during the winter season. Few dealers on this coast ever plan such campaigns either because the possibility of business along this line has not been brought to their notice or because they do not feel that any special effort to get such work is worth while. On the contrary, very little effort is required to secure this class of work.

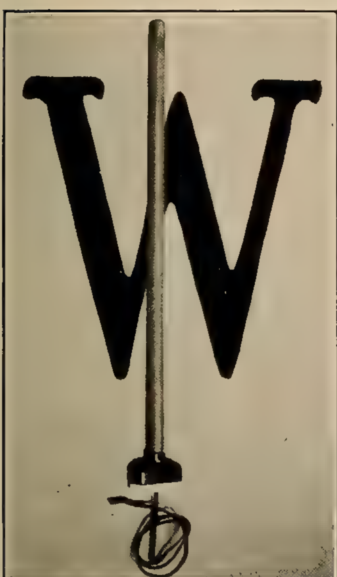
If a customer has a fan which is not in running condition it is human nature that he will not take any steps to have the repairs made until he needs it. However, if such matters are brought to his attention he will probably realize the necessity of having the fan overhauled at once. Even though actual repairs are not required almost every fan owner is willing to pay a reasonable price—to have his fans thoroughly cleaned and oiled. It seems this should be a good field for at least one dealer in every town.

FUEL OIL AND STEAM ENGINEERING

(Temperature measurement in fuel oil and steam engineering practice is a constant necessity. The conversion of the Fahrenheit and Centigrade scales often adds confusion, while the choice of the proper type of instrument for measurement of the particular temperature involved is often a delicate problem in engineering. In this article all these subjects are discussed and illustrative instances cited to assist the reader is acquiring a clear conception of the principle involved.—The Editor.)

MEASUREMENT OF TEMPERATURES IN FUEL OIL AND STEAM ENGINEERING PRACTICE

BY ROBERT SIBLEY



A Thermocouple for High Temperature Measurement

WHEN the finger is inserted into a cup of warm water and then again into water formed by the melting of ice a distinct sensation is felt in each case. Many years ago scientists and philosophers attempted to explain this sensation by assuming that a substance existed which they called "caloric" whose entrance into our bodies caused the sensation of warmth and whose egress therefrom gave the sensation of cold. But heat, if a substance at all, cannot be similar to those substances with which we are familiar, since a hot body weighs no more than one which is cold.

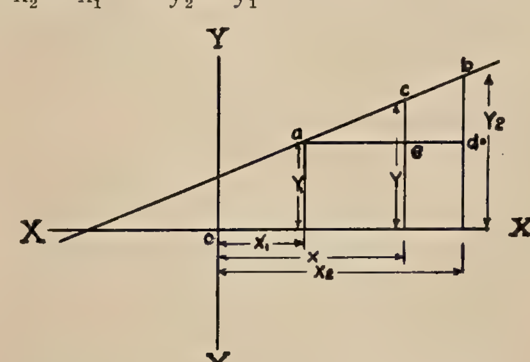
The discussion in this article is not concerned directly with heat but rather with one of its effects, namely, that of change in temperature. From the above it is readily seen that temperature is an indicator of the physical effect of heat rather than a quantitative means of heat measurement. This statement is easily proved, for when we place our fingers alternately upon a piece of cold and hot iron at the temperatures mentioned for water in the opening paragraph of this discussion, the same physical sensation is experienced. Yet to transform the iron from a temperature of freezing water to that of boiling water takes far less heat than for the transfer of water under similar conditions.

Fixed Points for Thermometer Calibration.—Since water is the most generally distributed substance throughout nature and one of the most convenient for handling in the laboratory its freezing point and boiling point are used by common consent as two definite marks for temperature calibration. Thus in the Centigrade scale the freezing point of water is the zero point and the boiling point of water under standard conditions of atmospheric pressure is the one hundred unit point. Again, in the Fahrenheit scale the freezing point of water is the thirty-second division point and the boiling point of water the two hundred and twelfth division point. Similarly for the Reaumer scale, the freezing point of water is the zero division point and the boiling point of water, the eightieth division point.

The Various Temperature Scales Employed.—The Centigrade scale as described above has grown into rapid use in scientific investigation and now may be said to be universally adopted throughout the world for such practice. The Fahrenheit scale, on the other hand, has so ingrained itself into engineering practice that engineers are loath to part with it in spite of its cumbersome and unscientific divisions. In this work, then, we shall be compelled to express temperature measurement in the Fahrenheit scale. The Reaumer scale, mentioned above, finds slight application in this country and in such places where it is employed it is used for measurement in stills and breweries. All three of these scales are often for scientific purposes transformed to a socalled absolute zero which is 459.4° F. below the ordinary zero on the Fahrenheit scale. A free discussion of this absolute scale will be set forth in a discussion on thermodynamic laws of gases which will appear later.

Relationship of Fahrenheit and Centigrade Values. In order that transfers from one thermometer scale to another may be conveniently and rapidly accomplished, it now becomes necessary to develop some simple mathematical relationships whereby this may be done. Since all of the scales are graduated uniformly between the freezing and boiling point of water, their relationship may be said to be linear. In the study of analytical geometry we find that such relationships may be expressed by the straight line formula:

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} \qquad \text{(1)}$$



The Linear Relationship of Temperature Scales

wherein x and y represent any simultaneous temperatures expressed in different scale readings and the subscripts 1 and 2 represent definitely known points in

correspondence. In order then to find a relationship between the Fahrenheit and Centigrade scale, if x represents the Fahrenheit and y the Centigrade, we find that x_1 would be 32 when y_1 is 0, and x_2 would be 212 when y_2 is 100. Consequently we derive a relationship thus:

$$\frac{F - 32}{212 - 32} = \frac{C - 0}{100 - 0}$$

$$F - 32 = \frac{180}{100} C$$

$$\therefore F - 32 = \frac{9}{5} C \ldots\ldots\ldots\ldots (2)$$

As an example, if the entering water in a boiler test is 84° F., this value is converted at once to the Centigrade scale by substituting in the formula

$$F - 32 = \frac{9}{5} C$$

$$\text{or } C = \frac{5}{9}(F - 32) = \frac{5}{9}(84 - 32) = 28.9^\circ$$

Relationship of Fahrenheit and Reaumer Values. A relationship between the Fahrenheit and Reaumer scales is similarly established.

$$\therefore F - 32 = \frac{9}{4} R \ldots\ldots\ldots\ldots (3)$$

Thus in order to illustrate the application of this formula a temperature of 84° F. reduces to the Reaumer scale as follows:

$$84 - 32 = \frac{9}{4} R$$

$$\therefore R = 23.1^\circ$$

Relationship of Centigrade and Reaumer Values. To develop a relationship between the Centigrade and Reaumer scales the same reasoning is involved.

$$\therefore C = \frac{9}{4} R - R \ldots\ldots\ldots\ldots (4)$$

Thus to convert a Centigrade reading of 28.9° into the Reaumer scale, we substitute directly

$$R = \frac{4}{5} C$$

$$\text{or } R = \frac{4}{5} \times 28.9 = 23.1^\circ$$

In case that rapidity is necessary in the conversion of one scale to another and extreme accuracy is not required, a conversion chart is easily constructed whereby these three scales may be converted graphically from one to the other.

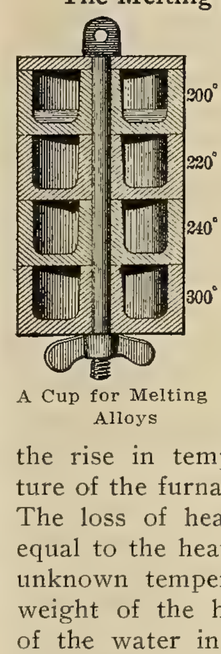
Methods of Temperature Measurement. The ascertaining of correct temperatures is of extreme importance. Due to the wide range of temperatures that occur in practice, a number of different methods of temperature measurement are necessary. The method to be employed depends upon the range of temperature involved and often too upon the accessibility of the object whose temperature is desired. We shall describe first the approximate methods that are used in the ascertaining of temperatures.

Estimation by Flame Color.—A number of years ago in the steel industry, it was found that a flame emitted definite gradations of color depending upon its temperature. In 1905 the Bureau of Standards issued a bulletin covering this point and made a statement that one may ascertain temperatures with an accuracy of 100 to 150° F. by means of eye judgment. It is stated, however, that it is impossible to ascertain temperatures above 2200° F. As this is the upper limit of furnace heating in steam engineering, we need not then be concerned with exceeding the limit.

In a booklet published by the Halcomb Steel Company, 1908, the following tabulation is given to aid eye judgment in estimating temperatures:

°C.	°F.	Colors.	°C.	°F.	Colors.
400	752	Red, visible in the dark	1000	1832	Bright cherry-red
474	885	Red, visible in the twilight	1100	2012	Orange-red.
525	975	Red, visible in the day-light	1200	2192	Orange-yellow.
581	1077	Red, visible in the sunlight	1300	2372	Yellow-white.
700	1292	Dark red	1400	2552	White welding heat
800	1472	Dull cherry-red	1500	2732	Brilliant white.
900	1652	Cherry-red	1600	2912	Dazzling white (bluish white)

The Melting Point of Metals and Alloys.—Another method of approximately ascertaining the temperature is by means of the melting points of alloys and metals. A number of these alloys are on the market and are convenient in ascertaining the approximate temperature of furnaces and other heat generating apparatus.



A Cup for Melting Alloys

The Method of Immersion.—A third method is by heating a piece of metal of known weight and specific heat to the temperature of the furnace and then immersing the heated body in water. By knowing the rise in temperature of the water, the temperature of the furnace may be approximately ascertained. The loss of heat in the hot substance is evidently equal to the heat gained by the water. Let t_x be the unknown temperature of the hot substance, M_x the weight of the hot substance in lb., M_w the weight of the water in lb., t_2 the final temperature of the water, t_1 the initial temperature of water, and c_x the specific heat of the hot substance; then, if we assume that the specific heat of the water is 1, we may write at once

$$M_x (t_x - t_2) c_x = M_w (t_2 - t_1)$$

$$\text{Therefore, } t_x = \frac{M_w (t_2 - t_1)}{M_x c_x} + t_2 \ldots\ldots\ldots (5)$$

Mean specific heats of a number of metals which may be used for this purpose are as follows:

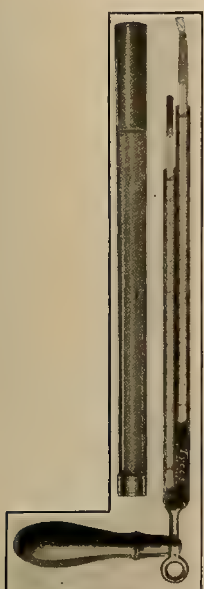
Mean Specific Heats.

Substance.	Ordinary Temperature.	Mean for High Temperature.
Platinum	.032	.038
Iron (cast)	.130	.180
Nickel	.109	.136

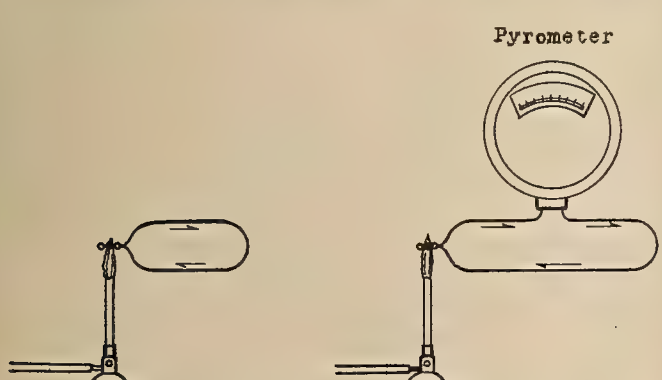
As an example let us suppose that 4 lb. of cast iron heated to an unknown temperature is plunged into 20 lb. of water at 64° F., thereby raising the water to a temperature of 124° F. By substituting in the formula, we have

$$t_x = \frac{20\,(124 - 64)}{4 \times 180} + 124 = 1731^\circ \text{ F.}$$

The Alcohol and Mercurial Thermometers.—For accurate temperature readings up to 900° F. the expansion of liquids is made use of, for experiment shows that the expansion of a liquid is proportional to the rise of temperature. Since alcohol has a low freezing point, in fact so low that it cannot be reached by any natural temperature, the alcohol thermometer is usually made use of for low temperature readings. Since its boiling point is also comparatively low, it is impracticable for high temperatures. Mercury, on the other hand, is an excellent substance to use in thermometers as the variation in its expansion coefficient with rise of temperature is such that the deleterious effect of the expansion coefficient in the glass tube is very nearly offset by the compensating error introduced by assuming a constant expansion coefficient for the mercury. Mercury boils at 676° F. and for many degrees below this point gives off considerable vapor. As a consequence the ordinary mercurial thermometer cannot be depended upon for a higher temperature than 500° F. An ingenious device, however, enables us to make use of the mercurial thermometer up to 800 or 900° F. A small amount of nitrogen gas is put in the upper column of the thermometer tube and as the mercurial column expands it consequently compresses the nitrogen gas. The reactive pressure of the gas upon the mercury raises its boiling point so that the high temperatures above indicated can be accurately read.



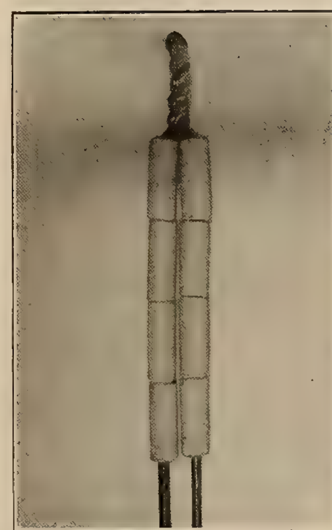
Hygrometer for Boiler Room Humidity



Principle of Operation of the Thermocouple

The Expansion Pyrometer.—For the estimating of temperatures higher than 900° a number of types of instruments are employed. The expansion pyrometer, which acts upon the principle that the expansion of metals is proportional to the rise in temperature may be quite accurately used between the range of 1200 to 1500° F.

Electrical Thermometers.—Electrical thermometers are, however, the most satisfactory and accurate for steam engineering practice. Electrical thermometers act upon two distinct physical principles. One class operates upon the principle that the junction point of two metals when heated generates an electromotive force which is proportional to the temperature rise. Consequently if the readings are made by means of a delicate galvanometer, calibrated to read degrees Fahrenheit, an accurate type of instrument is at once evolved. The other principle is based upon the experimental fact that the resistance of a metal varies with the temperature rise. Hence, by measuring this rise in electrical resistance by delicately calibrated instruments, an accurate thermometer results. The thermocouples made use of for the former type of electrical thermometer usually consist of platinum with platinum alloyed with 10 per cent of rhodium. In the latter class the resistance element is enclosed in a highly refractory substance.

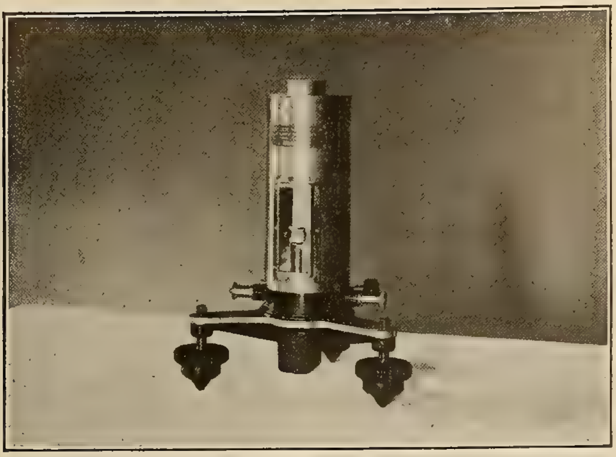


Thermocouple Ready for Insertion in the Furnace

The Radiation Pyrometer.—Where temperatures are above the limit of measurement by rare metal pyrometers, or where the point of high temperature is inaccessible to the thermal-couple, the radiation pyrometer is employed. This instrument is focused on the hot body at a distance. The heat radiating from the object under investigation is reflected by a concave mirror in the back of the pyrometer telescope and concentrated at a focus point on a small thermo-couple. This thermo-couple gives off electrical energy proportional to the temperature of the radiating body, and as a consequence the temperature is thus ascertained.

Thus, the whole range of temperatures met with in engineering practice is covered by some form of accurate temperature indicating device. The Bureau of Standards at Washington is ready to calibrate for a small fee any thermometer sent to them. At least one carefully calibrated thermometer should be kept for reference or comparison in the laboratory of any one interested in steam engineering testing.

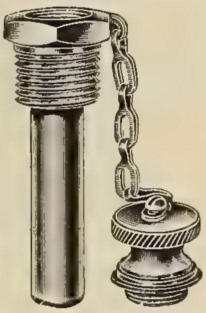
Standardization and Testing of Thermometers. The testing of thermometers is of utmost importance. All thermometers should be carefully calibrated for refined steam engineering tests. The Bureau of Standards has issued in its circular No. 8, an excellent guide for such work. All thermometers



Galvanometer for Delicate Temperature Measurement

are calibrated when completely immersed in the substance whose temperature is being ascertained.

The Stem Correction.—In engineering practice temperatures of steam and water are usually ascertained by setting the thermometer into a well which is sunk into the pipe conveying the steam or water. This well is filled with mercury or oil and the heat transferred to the thermometer by conduction. As a consequence, however, a portion of the thermometer protrudes in the atmosphere above the well and is consequently at a lower temperature. A socalled stem correction is hence necessary to ascertain the correct reading of the thermometer.



Well for Thermometer Insertion

This correction is large if the number of degrees emergent and the difference of temperature between the bath and the space above it are large. It may amount to more than 35° F. for measurements made with a mercurial thermometer at 750° F.

The stem correction may be computed from the following formula:

$$\text{Stem correction} = K\ n(t_2 - t_1) \qquad (6)$$

K = factor for relative expansion of mercury in glass; 0.00015 to 0.00016 for Centigrade thermometers; 0.000083 to 0.000089 for Fahrenheit thermometers, at ordinary temperatures, depending upon the glass of which the stem is made.

n = number of degrees emergent from the bath.

t_1 = temperature of the bath.

t_2 = mean temperature of the emergent stem.

Thus suppose that the observed temperature was 100° C. and the thermometer was immersed to the 20° mark on the scale, so that 80° of the mercury column projected out into the air and the mean temperature of the emergent column was found to be 25° C., then

$$\text{Stem Correction} = 0.00015 \times 80 \times (100 - 25°) = 0.9°.$$

As the stem was at a lower temperature than the bulb, the thermometer read too low, so that this correction must be added to the observed reading to find the reading corresponding to total immersion.

MATTER AND ELECTRICITY IDENTICAL.

Some startling ideas as to what man and the universe are made of have been set forth by the famous scientist, Robert A. Millikan, Professor of Physics in the University of Chicago, in the annual "Hitchcock Lectures" which he has just been delivering at the University of California. Here are some of the achievements and discoveries of science of today which he expounded:

The distinction between electricity and matter appears to be broken down.

Electricity possesses the only distinguishing characteristic of matter—inertia.

The atom is nothing but a tiny group of positive and negative charges of electricity.

Transmutation of some of the elements may be watched in the laboratory.

The eighty-one elements are not eighty-one different things—they are merely different arrangements of electrical charges.

It has been revealed that three elements exist which still await discovery.

One element differs from another element only because it has a larger number of positive and negative electrons in its atom than the element next lighter, and this variation in number is governed by a perfectly definite and regular law.

The electrical charge has been measured of the electron—the ultimate electrical particle.

The amazing minuteness of the quantities the scientist has learned to measure is illustrated by the fact that there are twenty billion billion molecules in a half a thimbleful of air, and that an atom is only a part of a molecule, and that a single one of the electrons of which an atom is made is only a hundred-thousandth as large as the atom — and yet this inconceivably minute bit of electricity has been accurately measured by Professor Millikan.

The X-rays knock off electrons from molecules at a speed of eighteen thousand miles a second.

Radium and its transformation products shoot off particles of helium at a speed of about 18,000 miles a second, and electrons with a speed of 180,000 miles per second.

The atom is mostly empty space. The nucleus of the atom consists of positively charged electrons held together by negatively charged electrons, with an equal number of negative electrons moving in orbital paths about the nucleus, and all together the electrons of an atom fill up no larger proportion of the total space which constitutes one atom than the sun, the planets, and our earth of the vast stretch of space included within the outer limits of the solar system in which man dwells.

These notable lectures at the University of California by one of the most distinguished of American scientists were made possible by an endowment left to the University by the late Charles M. Hitchcock for an annual series of lectures on "scientific and practical subjects."

SPARKS—Current Facts, Figures and Fancy

(A knowledge of important world facts of current interest is essential to present day living in the engineering world. Herein are set forth several gleanings from the survey of thirty magazines that should assist the engineer in acquiring a hasty, yet comprehensive enlightenment on some of these problems.—The Editor.)

The total value of farm production in the United States for 1916 broke all previous records—almost reaching the thirteen and one-half billion dollar mark.

* * *

The total wealth of the United States is estimated at one hundred and eighty billion dollars. The European war has cost to date about thirty-eight billion dollars, or one-fifth the total wealth of the American Republic.

* * *

Contrary to usual prognostications regarding the effect of the war on the copper output, the United States itself during 1916 for the first time in history consumed more copper metal than the rest of the world all combined.

* * *

"Does the school on wheels now operated by the Southern Pacific Company mark a new era in education?" Twenty-five children are taught daily in an abandoned passenger car. This is for the benefit of the children belonging to the section gang on the railroad.

* * *

"Shall clocks be sent ahead one hour" is receiving national attention this month. Germany, France, England, Italy and other countries have adopted the system. Cleveland and Detroit in 1914 set their clocks an hour forward. It is said officials and commercial organizations in these cities testify the change was made without the least difficulty and has met with universal favor.

* * *

Regenerative breaking, in which power is not only generated on down hill hauls but a remarkable saving in shoes for brakes is brought about, has proved so eminently successful on the electrification of such transcontinental lines as the Chicago, Milwaukee & Puget Sound that undoubtedly the near future will see an unprecedented impetus in this direction of electrical application.

* * *

From the United States Bureau of Mines comes word that the new mine-rescue car to be stationed at Reno will be ready shortly. This steel car will be equipped with all sorts of life-saving and rescue devices, manned by a mining engineer, a mine surgeon, a foreman miner, a first-aid miner and a clerk. Its purpose is to offer aid at any mine should an accident occur and to travel over Nevada, western Utah and eastern California, teaching mine owners and operators first aid and how to make underground safer. It will spend ten months in the field and the balance of the year be stationed at Reno.

Marshall Field is said to have won his phenomenal success by remembering but twelve essential business principles: the value of time, the success of perseverance, the pleasure of working, the dignity of simplicity, the worth of character, the power of kindness, the influence of example, the obligation of duty, the wisdom of economy, the virtue of patience, the improvement of talent, the joy of originating.

* * *

The organizing of employees whose work is closely allied into groups in order that papers and discussions at meetings may benefit departmental intercourse and individual members in their daily work is the plan of the hour among such national organizations as the National Electric Light Association. The recent formation of the Pacific Coast Section of this association will aid much in forwarding this plan west of the Rockies.

* * *

Commuters living across the bay from San Francisco had an unusual opportunity of studying daylight phenomena from Dec. 21, 1916, to Jan. 11, 1917, due to the clear mornings. The fact was soon brought to light that, although the net increase in the day begins on December 21, still the sun does not begin to rise earlier until ten days later due to the earth's rounding that portion of the ellipse peculiar to its orbit at this season of the year.

* * *

Deer that wander along the right-of-way of the Southern Pacific Company at night can now be assured of the full protection of the Company's Safety First rules. For Superintendent J. D. Brennan of the Sacramento Division has told his engineers who pilot trains over the Sierras to be careful about running over them. They will momentarily dim their headlights should a deer get on the track and be dazed by the glare, so that the animal can recover his presence of mind and jump to safety.

* * *

Aluminum, the close competitor of copper for transmission line purposes, shows a big increase in production during the past year. The domestic consumption of aluminum in 1916, according to estimates made by J. M. Hill, of the U. S. Geological Survey, of the Department of the Interior, was over one hundred twenty million pounds. The estimates are based on statistics of the domestic production for the year and of the imports for nine months. This is an increase of more than twenty-one per cent over the consumption of 1915.

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CONTENTS

An Electrical Method of Water Testing

The subject of directness in water testing for boilers and condensers used in the modern central station has long been a goal toward which power plant operators have worked, but until recently with rather discouraging outcome.

Especially was this true in ascertaining the salt contents of condensate where leakage was encountered from the circulating water pumped from the ocean.

Once again electricity has come forward to aid the steam side of the power plant in efficiently and rapidly determining the salinity of boiler water and condensate.

Since the salinity of the liquid directly affects the resistance of a given quantity of water, by predetermining the resistance and the corresponding salinity of definite samples, there has now been worked out in one of the great power plants of the West an effective method of rapidly determining the condition of the water in the boiler and condenser.

This accomplishment described on another page of this issue once again advances engineering method for ingenuity and efficiency to a still higher plane.

More Effective Technical Service Needed

Universities and technical institutions of the West have rendered a valuable service to their various commonwealths by sending forth young engineers that have assisted in a remarkably high degree of efficiency in solving the great economic and industrial problems in the commercial development of this section.

In this later day of thinking, however, it is becoming more and more to be recognized that the institution which does not through its engineering departments render valuable service to the development of the state in helpful gratuitous advice to its people, is failing in a duty which it owes to the state. Indeed, failing in a duty which from the very fundamental conception of a university as a disseminator of knowledge it must perforce perform.

Long since it has been recognized that agricultural advice to the people of a commonwealth is of paramount importance, and well it may be so recognized for upon the development of agricultural industries of a commonwealth depends much for the happiness and welfare of its people. But in the West the economic development of waterpower and its efficient utilization ranks almost upon this same plane of usefulness.

To the University of Oregon, through its department of Industrial and Commercial Service, must be given the credit of being the first to effectively extend this helpful technical advice to its citizens. Though outranked by both California and Washington in possible water power development, the technical men at this state university have just published an elementary primer of electricity for light and power customers, reviewed elsewhere in this issue, that will prove invaluable to power users throughout the West.

The book is so simple in construction and yet so practical and free from high sounding technicalities as to make it at once of high value to users of electricity.

This is only a beginning of the great work of service ahead for engineering faculties of the West. These faculties are in a large measure composed of the best brains that America is today producing and the citizens of Western commonwealths look to them not only for technical instruction of their children but for timely technical advice in the solution of the engineering problems that hinder at present economic use of the great national resources of their respective districts.

The Influence of Electricity in the Home

Much has been said of the gigantic profits to the power company and the economic saving to the domestic consumer by the utilization of modern electrical cooking appliances in the American home. Little has, however, been expressed concerning the ultimate influence this trend toward utilization electrical will have upon the moral tone of domestic life.

Thoughtful consideration leads one to a most interesting speculation on the probable influence this complete changeover to electrical operation is bound to have upon the coming generation.

The cry of the nation during the present generation so far as the feminine half of the population is concerned has been for a liberation from the irksome duties of the household life. The dirty, sooty saucepan and kettle have undoubtedly been the initiatory stumbling block that has led up to many a family inharmony.

It is difficult to imagine a more cleanly, artistic freedom than is felt in the kitchen operated entirely electrically. The very atmosphere itself seems to partake of a breath of freedom hitherto unexperienced in the home.

The article found on another page of this issue on "Home Economics Electrical" by the head of the department of domestic science in the Portland city schools is timely and clearly indicates that there is now being felt in the Western home electrical a new ethical influence due solely to the uplifting force felt from the cleanliness and directness of electrical application.

A New Use for Electric Pumping

The experimental drain of the Kearney vineyard, detailed elsewhere in this issue, marks a result that bids well for the reclamation of large areas of alkali lands in the West and the consequent consumption of enormous electrical energies in the future.

The land in question is owned by the University of California. An area of 160 acres previously productive but which in 1912 had become badly alkali was selected for the experiment of draining and re claiming by means of the electrical pump. The alkali in the surface foot varied from less than 0.2 per cent over most of the tract to 30 per cent over small areas. The principal salts were sodium chloride and sodium carbonate, the former predominating.

The results of the flooding by means of electrical pumping indicate that a total of 285 tons of alkali salts have been removed from the tract. The average alkali content is now less than is usually considered detrimental to crops.

The cost of the work proved much higher than it is estimated should be necessary for similar effort in the future due to the experimental nature of the first test. Sufficient data have been gathered to show that the scheme is thoroughly feasible from an economical point of view for many tracts of alkali lands in the West hitherto abandoned as worthless.

This again is another instance where electrical energy may safely be counted upon to play a most important role in future reclamation of the fertile lands of the West.

A Constructive Business Regime

The story of the two frogs will undoubtedly long linger in the minds of all who have ever heard it. The one frog, realizing he had been entrapped in the dairyman's milk can, looked about himself and overcome by the futility of further effort to live, simply gave up and croaked upon the spot. The other frog, however, though fully appreciative of his perilous situation, determined to kick and splash until every bit of vitality within himself should be exhausted. The result was that when the milkman opened the cans he found in one a dead frog but in the other, serenely perched upon an island of butter, sat his froglike majesty, a monarch of all he surveyed.

And so all those who heard the recent talk of the general agent of the Wells Fargo Company before the San Francisco Electrical Development & Jovian League who had ever heard of the frog story could not but ponder in mind the close similarity of the struggle of the express company to that of the persevering frog.

The lesson that was learned at that meeting can not help but deeply implant itself among those of the electrical fraternity present.

The express company finding itself face to face with the parcel post enactment some years back was decidedly in an unenviable position. The detailing of actual instances of how the company officials in the face of the most discouraging conditions have built up new markets and new outlets for service that not only have proved of immense financial benefit to the company, but that have added material prosperity to the community it serves carries with it a wonderful lesson to power companies and indeed to all interested in the future of the electrical industry.

The taking away of business from a competitor may perhaps for the time being benefit the victor, but the sum total of usefulness of an industry engaged in serving the needs of man is not heightened one iota. He however, who looks afield and creates new channels of outlet for business enterprise and service is indeed the true empire builder.

And so it would seem that in all plans for local constructive business effort the leaders in electrical development will do well to carefully consider whether or not the activity proposed will simply result in taking over a service already handled by others or whether new dollars are set rolling and new life giving enterprises are created thereby.

PERSONALS

G. N. Simonson, of the department of electricity in the state engineer's office was a recent San Francisco visitor.

Foster C. Gibson, Seattle manager of the Edison Storage Battery Supply Company, spent a few days at San Francisco recently.

R. T. Stafford, manager of the Seattle office of the Allis-Chalmers Company, was a recent business visitor at San Francisco.

James F. Rogan, Los Angeles manager of the Edison Storage Battery Supply Company, was a recent business visitor at San Francisco.

B. J. Klein, Pacific Coast manager of the Bristol Company of Waterbury, Conn., recently returned to San Francisco, after an extended trip throughout the Northwest.

A. O. Kuehmsted of the Electric Credit Association of Chicago, also with the Gregory Electric Company of that city, was a recent business visitor on the Pacific Coast.

T. W. Simpson, Pacific Coast manager of the Federal Sign System (Electric), recently returned from a short business trip throughout the southern part of his territory.

W. S. Berry, sales manager Western Electric Company of San Francisco, leaves for Honolulu in company with Mrs. Berry on the 21st of this month and will return on the 10th of April.

W. S. Greenfield, general manager of the H. W. Johns-Manville Company of San Francisco, recently returned from an extended trip throughout the southern part of the state, where he visited his different branch offices.

H. I. Markham, general manager and vice-president of the Federal Sign System (Electric) of Chicago, recently arrived from the East on a tour of inspection of the twenty-six branches of the company throughout the United States.

H. V. Carter, formerly president of the Pacific States Electric Company, has recently organized the H. V. Carter Motor Company, handling the Marion-Handley, at 714 Van Ness avenue, San Francisco. **C. H. Carter**, his son, is the manager of the Los Angeles branch.

W. B. Burbeck, formerly assistant to the manager of the sales department of the Pacific Gas & Electric Company of San Francisco, recently decided to leave the electrical industry to accept a position as a member of the board of managers of Roos Bros., Inc., located at Oakland.

Chas. Murphy, until recently with the Great Western Power Company, and formerly vice-president and general manager of the United Light & Power Company, has severed his connections with that company and is leaving for Chicago to take up the position of general manager of the American Public Utilities Company, which operates street railways, hydroelectric plants and steam heat stations in Indianapolis, Salt Lake, Wisconsin, Michigan, Illinois, Mississippi and the middle West.

Francisco Fernandez-Marque, electrical engineer, Ferro Carril Central del Paraguay; residence Avenida Ascuncion No. 367, Acuncion, Paraguay, South America; **Alexandro Dryzurgh Gilmour**, superintendent engineer, Compania de Salitre y Ferro-Carrilde Junin, Alto de Junin, Iquique, Chile, S. A.; **Russell Gould**, superintendent of power, Northern Electric Railway, residence 932 Butte street, Chico, Cal.; **Howard Luis Lamb**, office and construction work, Otis Elevator Company, Casilla 3760, Santiago, Chile, South America; **Charles Parker Osborne**, superintendent of power, Portland Railway, Light & Power Company, Electric Building, residence 761 Clinton street, Portland, Ore., have recently been elected as associates of the American Institute of Electrical Engineers.

MEETING NOTICES

Joint Luncheon of Portland Sections of N. E. L. A. and A. I. E. E. With Oregon Society of Engineers.

The bi-weekly luncheon of the joint local sections of the A. I. E. E., N. E. L. A. and Oregon Society of Engineers was held in the Orange Room of the Oregon Hotel at noon January 31, 1917. Clarence Young of the Pacific Power & Light Company was chairman of the day. Municipal Judge Stevenson gave a short talk on the "Reformation of the Average Citizen." The attendance was fifty.

California Section of Electrical Inspectors

The regular monthly meeting of the California Section of the National Association of Electrical Inspectors was held Saturday, January 27th, in the Merchants' Exchange Building. There was a large attendance and the meeting proved to be the most interesting held for some time. Practically the entire session was devoted to a study of the California Electrical Utilization Safety Orders. As would be expected the general question of grounding created the most discussion.

San Francisco Section A. I. E. E.

The San Francisco Section of A. I. E. E. held its regular monthly meeting at the Engineer's Club, on Friday evening, January 26th. The meeting was preceded by a dinner party composed of such of those members who found it convenient to be in attendance at the dinner hour.

The program of the evening was a talk by A. H. Babcock, consulting electrical engineer for the Southern Pacific Company. Mr. Babcock described in a most interesting manner many of the engineering details used in the great electrified systems of the East visited by him on a recent Eastern tour.

Los Angeles Jovian Electric League

A splendid program was given at the luncheon January 31st. President A. E. Morphy presided and Albert W. Childs, superintendent of sales for the Southern California Edison Company, acted as chairman of the day. The guest of honor and speaker of the day was Thomas Brookes Fletcher, editor of the Tribune, Marion, Ohio. He was introduced by Harry R. Miner, manager of Repath Bureau, who in a short address told of the work of Mr. Fletcher, of whom he said that while a practical business man and editor of an Ohio newspaper, was without question the most popular man on the American platform today.

The subject of Mr. Fletcher's address was "Is California the 'Boob' State?," an intensely interesting, instructive and constructive talk, that was probably the best ever given before the league.

San Francisco Electrical Development and Jovian League

Wednesday, January 31st, meeting was Bobbie Burns day, being the 158th anniversary of the birth of the famous Scotch poet. Robert Robertson was speaker of the day.

The members adopted unanimously the amendments to the by-laws of the League providing for a slight increase in the monthly dues made necessary to meet the increased annual dues to the Jovian Order, as well as take care of necessary incidental expenses of the League. A motion was also adopted that the league take in hand the preparation of a standard set of specifications and a committee was appointed to take the matter in hand. The personnel of the committee is to be announced later by President Newbert.

The meeting of February 7th was devoted to a discussion of plans and purposes of the new geographic section of the National Electric Light Association recently formed. Captain H. F. Jackson of the Sierra & San Francisco Power Company, forcefully presented strong arguments in favor of the development league backing the new undertaking in every way possible. Albert Ergot, vocational secretary of the Young Men's Christian Association, followed with a most interesting discussion of the employment problem especially in the life of the young boy.

THE ELECTRICAL "BASEBALL GERM"

The "Baseball Germ," that created so much excitement and enthusiasm, in the electrical game last year, has decided to put an end to his long winter's nap, so he quietly made his escape, and is now out looking for promising material, to assist him in making this a banner year for the National pastime.

The electrical man, has already been paid a visit by this strange little insect, consequently, the league that proved such a great success last year has been reorganized. There are only four teams this year, the Electric Railway & Manufacturers' Supply Company, General Electric Company, Pacific States Electric Company and the Western Electric Company. These teams constitute what is known as the Electrical Baseball League.

The teams have already started practice, and each manager has discovered an unusual amount of talent on his club, therefore you can look forward to some mighty good games during the coming season.

Kahn, the "States" new manager, has practically the same championship club to start this season with, while Rylander, the leader of the "ERMSCO" nine has only four veterans of last year, trying for positions on his team. He has plenty of new material on hand however, so he should have little trouble in collecting a very good ball club.

The Western, under the leadership of Johnnie Steffens, looks like a strong bidder for the trophy, as he has a hard hitting bunch of ball players that are always in the game. The G. E. Company were unfortunate enough to lose two of their stars of last year, and it will be a difficult task for Fred Rea, their manager, to find two men capable enough in the organization, to fulfill the vacated positions.

The second annual dance given by the Electric Baseball League has been arranged to take place Friday, February 16th, at Maple Hall in this city. The proceeds will be used to cover the expenses of the league during the season of 1917. The tickets are already on sale and can be secured from any member of the above mentioned organizations. A large crowd is expected and a good time assured, so all are cordially invited to attend.

Everything has been arranged now and all that remains to be done is the playing and rooting and March 10th will find plenty of that, providing J. Pluvius will permit.

Announcement of grounds and full accounts of all Electrical League games will be found in later issues of this publication.

ELECTRICAL	ERMSCO.	General.	States.	Western.
At ERMSCO	BASEBALL	April 14 May 26 July 7	March 31 May 12 June 23	March 17 April 28 June 9
At GENERAL	March 24 May 5 June 16	LEAGUE	March 17 April 28 June 9	March 31 May 12 June 23
At STATES	March 1 April 21 June 2	April 7 May 19 June 30	SEASON	April 14 May 26 July 7
At WESTERN	April 7 May 19 June 30	March 1 April 21 June 2	March 24 May 5 June 16	1917

Date.	Visiting Club.		Home Club.	Date.	Visiting Club.		Home Club.
March 10.	ERMSCO	vs.	States	May 12.	States	vs.	ERMSCO
	General	vs.	Western		Western	vs.	General
March 17.	Western	vs.	ERMSCO	May 19.	ERMSCO	vs.	Western
	States	vs..	General		General	vs.	States
March 24.	ERMSCO	vs.	General	May 26.	General	vs.	ERMSCO
	States	vs.	Western		Western	vs.	States
March 31.	States	vs.	ERMSCO	June 2.	ERMSCO	vs.	States
	Western	vs.	General		General	vs.	Western
April 7.	ERMSCO	vs.	Western	June 9.	Western	vs.	ERMSCO
	General	vs.	States		States	vs.	General
April 14.	General	vs.	ERMSCO	June 16.	ERMSCO	vs.	General
	Western	vs.	States		States	vs.	Western
April 21.	ERMSCO	vs.	States	June 23.	States	vs.	ERMSCO
	General	vs.	Western		Western	vs.	General
April 28.	Western	vs.	ERMSCO	June 30.	ERMSCO	vs.	Western
	States	vs.	General		General	vs.	States
May 5.	ERMSCO	vs.	General	July 7.	General	vs.	ERMSCO
	States	vs.	Western		Western	vs.	States

COMMISSION NOTES

Notes of Utilities Commission of Idaho

In regard to the matter of J. T. Wiseman, et al., plaintiffs, vs. Rupert Electric Company, a corporation, defendant, it is ordered, that defendant repay to the persons entitled to receive such repayment, all sums heretofore collected from them as meter deposits, by crediting such persons with the sum of 75 cents per month on their respective monthly bills until such deposits are fully paid; provided, however, that any person or persons entitled to receive such repayment, who have ceased or shall hereafter cease taking electric service from defendant, shall be paid in cash the amount of such deposits found to be due them.

It is further ordered, that from and after February 1, 1917, defendant charge and collect 25c per h.p. per month for each rated horsepower of installation for motor service, and a minimum charge of $1. per month for illumination and household purposes.

It is further ordered, that defendant, on or before February 1, 1917, file with this commission a schedule of rates, rules and regulations in conformity with the orders made herein.

In the matter of the complaint of certain citizens of the village of Shelley, Idaho, in regard to electric service furnished said village and its inhabitants by the Shelley Light & Power Company, Limited, the commission has ordered a complaint filed against the company by the attorney-general of Idaho.

In the matter of the application of the Idaho Power Company for a certificate of convenience and necessity covering the village of Hazelton, Minidoka County, Idaho, the commission has granted the request.

Arizona Corporation Commission

It is ordered that all common carriers and the owners of all railroads engaged in intrastate commerce in the State of Arizona be, and they are hereby required hereafter, to file in the office of this commission on or before the 31st day of March in each year, reports covering the period of twelve months ending with the 31st day of December preceding said date, giving the particulars heretofore called for in the annual reports required by the commission of said carriers and owners of railroads.

Notes of the California Water Commission

Permits to appropriate water have been granted to the following by the State Water Commission.

The Walker Mining Company of Salt Lake, 20 cu. ft. of the waters of Ward and Nye Creeks, in Plumas County, tributary to the Feather River, for power purposes. There is a flume and pipe line 7692 ft. long. Electrical energy will be developed to propel mining and milling machinery and sawmill. The total fall to be utilized is 514.4 ft., and it is proposed to develop 1169 theoretical horsepower at a cost of $25,000.

The Cheney Slough Irrigation Company of Colusa, 162 cu. ft. per second of the waters of the Sacramento River, for irrigation purposes, subject to the superior navigation rights of the United States. There will be a pumping plant of two units electrically driven. One motor will be of 300 h.p., driving a 36 in. centrifugal pump, and the other of 150 h.p., driving a 26 in. pump. The range of lift is from 8 to 23 ft., according to the stage of the river. The estimated cost is $50,000, and the acreage to be irrigated 10,663 acres.

TRADE NOTE

With a record of selling 180 electric washing machines in 1916 and with excellent chances of surpassing this achievement during the coming year, the Alliance (O.) Gas & Power Company recently placed an order for a carload shipment of this appliance.

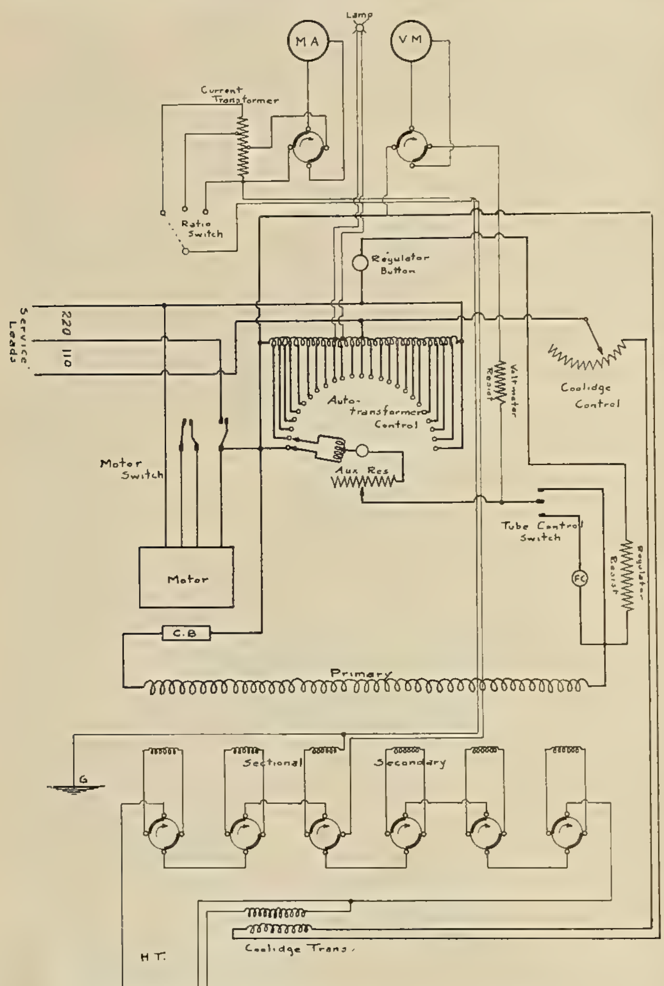
LATEST IN EVERYTHING ELECTRICAL

(The X-ray apparatus has long been recognized as a potent factor for further application of electricity to medicine. Here is a description of an invention recently perfected and successfully put on the market by a young man who is the product of a Western university and the son of a prominent professor in that university. Above all other considerations, however, unusual interest attaches to the invention in that a distinct advance is herein made for future usefulness of the X-ray apparatus in its service to mankind.—The Editor.)

NEW ADVANCES TOWARD A CLOSER RELATIONSHIP OF ELECTRICITY AND MEDICINE

BY FRANK RIEBER

The Electro-Therapeutic field, in the broadest sense, includes all the applications of electricity to medicine and surgery. Among these are the generation of heat, as in cautery and sterilizer apparatus; the production of light of various natures,—as the Ultra-Violet, Finsen, and Roentgen rays; the operation of small tools, such as dental and surgical motors, and the operation of recording and testing devices,



Electrical Connections for X-ray Operation

such as the cardiagraph. Many of these applications, however, have a rather questionable value, and much work will be necessary before they can be standardized.

The production and control of Roentgen rays offers an excellent field for development, on account of the fact that problems connected with their use are of a mechanical and physical nature rather than of a physiological nature. The results to be attained are obvious and definite, at least so far as they are of use in diagnosis. A clear image on the fluorescent screen for the observation of transient phenomena, or conditions within the body, must be supplemented with the ability to make a photographic record of those conditions.

Not only are these rays used to examine or photograph conditions within the human body, but they have even been found to have certain definite curative properties.

Just as bacteria are destroyed by the action of sunlight, so it has been found that certain cells are destroyed by the action of the Roentgen rays.

The cells of many types of cancer, for instance, are either restricted in growth or destroyed entirely, by a sufficient exposure to the rays.

Interior Views showing Novel Arrangement of Converter Connections

This treatment requires the utmost care in its administration, as the action of the Roentgen ray on the normal body cells is only slightly less destructive than its action on malignant cells.

Surgery has therefore demanded from the other sciences an apparatus by the use of which the quantity and quality of the Roentgen rays could be more accurately controlled.

An additional demand has been for a machine supplying current of higher voltages, as such current produces Roentgen rays of greater penetrative power, more adapted to reach the deep tissues.

The apparatus for doing these things should be as consistent and positive in action as possible. It should afford means of controlling and measuring the essential factors in the rays employed and should require the use of the personal factors of estimation and judgment only when absolutely necessary. All other changes and adjustments should be made automatically and should be mechanically as simple and rugged as possible.

All who have made any considerable use of Roentgen apparatus as at present commercially supplied, must realize that some of these conditions are not met to any great degree, and that considerable improvement might be reasonably expected.

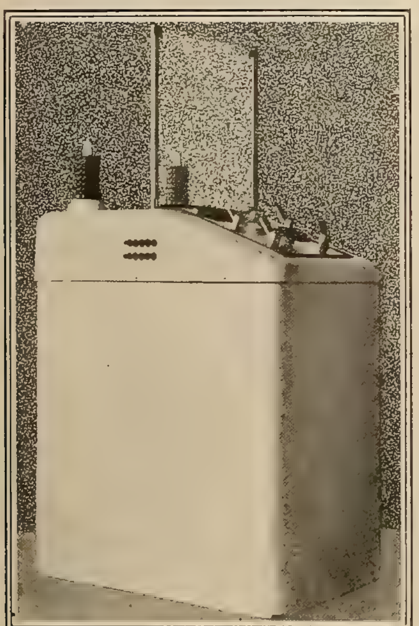
The machine here illustrated has been recently developed to satisfy these demands. It has the ability to furnish direct current at a potential of one hundred and twenty thousand volts, a far higher potential than has ever been successfully delivered by any similar apparatus.

It has, in addition, provisions for measuring and prede-

termining the quantity and quality of the rays with the greatest ease and accuracy.

The capacity of this machine is unusually large, enabling treatments to be administered to as many as ten patients at one time. On a recent test before members of the American Roentgen Ray Society, the equivalent of over thirty-five horsepower was delivered for a short time to a single X-ray tube.

This enormous power was delivered without a sound from the apparatus. To appreciate the value of this attainment, it should be understood that the usual type of apparatus is



The New Rieber Converter

so noisy in operation that its efforts on a nervous patient have heretofore constituted one of the most prominent bugbears of the Roentgenologist.

The work of taking pictures by the use of the Roentgen rays has also been greatly simplified, a few measurements in standard physical units have supplanted the former uncertain and arbitrary methods of computing results.

In recounting the steps in the solution of a problem it is best to begin with a clear outline of the known conditions and facts which must be taken into account. An outline of this nature must therefore be included here.

Roentgen-Rays. Roentgen rays have recently been identified as ether vibrations of the same nature as visible light. Their wave length is, however, extremely short. It is on account of this short wave length that these rays possess such a marked penetrative effect for bodies which are opaque to ordinary light.

Taking visible light as a working analogy we have in the X-ray two factors which may vary; one of these factors is the penetrative power of the ray. This varies with the wave length and corresponds to the variations in color in visible light. The other factor is the intensity of radiation. This corresponds to the strength or intensity of visible light and obeys the same laws with regard to decrease at a distance.

Tubes. The accepted means for the production of these rays is to pass an electric current through a specially constructed tube. This usually contains gas in a very rarified condition. It has been found that the penetration of the rays emitted from these tubes increases, in a very definite relation with the increase of the electrical pressure applied to the tube. The intensity of the radiation is directly proportional to the electrical current passed through the tube.

Control of Penetration. In examining the human body by means of the Roentgen rays, it is found, in practice, that the penetration of these rays must have a certain distinct value for every part to be examined, if the maximum detail and contrast in that part is to be shown. A control of the penetrative power of the rays is thus of prime importance.

Control of Intensity. The intensity of radiation and the time of its duration are factors which determine the danger to which the patient is exposed in making an examination. Therefore, in making examinations with the fluorescent screen the intensity of radiation is kept as low as is consistent with obtaining a good view of the part under examination and the time during which the patient is exposed must be restricted so that no dangerous results will follow.

In making photographic records with the rays the product of the time and intensity determine the degree of exposure the plate will receive just as the intensity of daylight determines the length of exposure with an ordinary camera.

X-Ray Apparatus to Date. The present apparatus for supplying current to X-ray devices is usually installed in a wooden cabinet of about the dimensions of an upright piano. In this apparatus the chief factors are a high tension transformer which receives alternating current from the supply mains at a potential of 220 volts and delivers it to the remainder of the apparatus at a potential of approximately 100,000 volts alternating current. Since a direct current is necessary for the operation of X-ray devices, this apparatus must also embody some means for converting this 100,000 volt alternating current into a 100,000 volt direct current. This is accomplished by a rotating switch mechanism operating in air and driven by a synchronous motor. This switch mechanism cannot for electrical reasons be constructed with a rotating diameter of much less than 20 inches, which for a number of reasons is unfortunate. It is difficult to balance the rotating member accurately and noisy operation is the natural result; also it is impossible to maintain the stationary switch member in actual mechanical contact with the rotating member of this device running at the necessary speed. The mechanical wear between the surfaces would approximate the action of a circular saw. It is therefore the practice to construct such a switch with a slight clearance between the rotating and stationary members. Because of the high potential the current to be switched is quite able to strike across the small mechanical gap that is interposed and the circuit is completed by a disruptive discharge or arc. The continual presence of this arc, which is very intense, gives rise to several serious difficulties.

First Basic Fault. The discharge within the present commercial X-ray machine, when used to make heavy exposures, gives rise to an alarming roaring sound, making it difficult to obtain pictures from nervous patients. A slight motion of the patient, when startled, is sufficient to entirely ruin the picture.

Second Basic Fault. A second difficulty caused by the presence of these arcs is the unstable electric condition to which they give rise. They constitute a variable and indeterminate electrical resistance; this renders an accurate control and standardization of the electric quantities involved an absolute impossibility.

Third Basic Fault. A third difficulty arises from the fact that these disruptive discharges produce large quantities of nitrous and nitric acids and oxides, which acting upon the metal members of the motor and rotating switch, cause a high degree of corrosion. The insulation of the motor is invariably attacked to some extent and finally the wooden cabinet in which the device is inclosed becomes thoroughly permeated with these acids. Considerations of cost as well as of the space involved cause reliance to be placed on the insulating qualities of this wooden cabinet to prevent leakage of the high potential current generated and delivered. Therefore, when this becomes soaked with acid, insulation failures immediately result.

Fourth Basic Fault. With few exceptions the apparatus commercially supplied at the present time for furnishing the high voltage currents used in exciting X-ray tubes contains the same fundamental defect, namely, high inherent impedance. To obtain a conception of the results of this impedance, let us take a mechanical analogy. Suppose one had an engine or motor of some sort which was called upon to do different classes of work. Suppose further that for each class of work a definite speed was required. Now consider what would happen, with the motor running at the required speed for some certain class of work if a large load were suddenly applied. Very obviously, unless a good governing device of some sort were present and able to act instantly, the motor would slow down and thereafter would work at an incorrect speed.

This is precisely what happens in the X-ray work. A physician may have several tubes, each of which has a different electrical resistance. Now if he desires to operate any one of these tubes at a certain definite penetration, it will impose a corresponding load upon his machine. This load may be vastly different for each of the three tubes. Therefore, although he may set his controlling switch at the same point for each of the tubes, unless means are provided for maintaining a constant voltage irrespective of load, he will not get the same penetration.

Another disadvantage arising from this "slowing down" of the machine is due to the variation in the resistance of an X-ray tube while in use. For instance, with the apparatus adjusted to generate a ray of the correct penetration to photograph a stomach, an exposure of several seconds may be required. About half of this exposure will have elapsed, perhaps, when the tube begins to warm up. This causes a large amount of gas to be driven from the walls and electrodes into the tube, and a larger demand of current is made upon the apparatus. The current is supplied, but at the cost of a large loss in penetration. Any Roentgenologist has several tubes on his rack which he has discovered need to be coaxed through an exposure by breaking the time up into several short periods.

The unsatisfactory results due to the faults outlined in the preceding have been largely overcome in the following ways:

The first, second and third difficulties enumerated were due to the actual nature of the construction of the rectifying mechanism. It therefore seems possible to construct such a rectifying mechanism which would accomplish the desired results, namely, the synchronous periodic reversal of the electric circuit without having the attendant fault of noisy operation and the formation of product destructive to the insulation. By reducing the diameter of the rotating switch mechanism to two inches it was found practicable to construct a switch the rotating and stationary parts of which were at all times in actual mechanical contact. It was then found possible to immerse such a switching mechanism in oil thereby increasing the effective resistance, decreasing the friction and reducing the noise of operation.

A switch of this diameter can be constructed to operate successfully on alternating potentials up to and including 40,000 volts. It was thought advisable however to maintain the potential applied to each switch at a considerably lower value. Therefore, as will be seen from the conection diagram, a number of these switches were constructed and operated from the same synchronous driving agency. By constructing a high tension transformer having a plurality of electrically separate secondary windings each of which is adapted to deliver a moderate alternating potential and by rectifying the alternating potential delivered from each of these secondary windings by one of the switch mechanisms just described and further by combining the resultant direct or unidirectional potentials in series, it was found possible to construct an apparatus capable of delivering a maximum potential of 120,000 volts and having the required operating characteristics. The fourth difficulty, namely, the inadequate control of penetration of the ray was overcome by substituting for the rheostat formerly included in the primary circuit for the purpose of controlling the delivered power an auto-transformer and by further reducing the inherent impedance of the electrical circuit to the lowest practical value.

BOOK REVIEWS

Elementary Primer of Electricity for Light and Power Customers. Size 6 in. by 9 in.; 95 pp.; replete with tables and information. Published by the Department of Industrial and Commercial Service, University of Oregon, H. B. Miller, Director. Free on application.

A Commonwealth Conference held at the University of Oregon during 1913, brought forth a later appointment of a number of specialists to study and investigate the hydroelectric interest of the state of Oregon. From this study it was found that approximately 3,500,000 undeveloped horsepower are dormant within the confines of that commonwealth with only a present development of 158,000.

This primer designed to encourage the consumption of electrical energy treats in a remarkably clear manner in an elementary, yet highly practical way the matters pertaining to electricity so often misunderstood in the public mind. Then follows discussions of electricity in the home and on the farm. The treatment throughout is so extraordinarily effective in its simplicity as to make this work of immense value to all interested in the electrical industry in the West.

Valuation, Depreciation and the Rate-Base. By C. E. Grunsky, Eng. D. and C. E. Grunsky, Jr., E. M. Size 6 in. by 9 in.; 387 pp.; replete with tables; cloth binding. Published by John Wiley & Sons of New York City, and for sale at the Technical Book Shop, San Francisco. Price. $4.00.

In this book the authors have given special consideration to a discussion of the non-agreement of the actual life of articles which have a limited period of usefulness with their probable or normal life. These results show that there is great advantage in adopting, instead of "present value," a rate-base without deduction of depreciation, which will include but little, if anything, other than legitimate and properly estimated cost as the starting point when rates are to be fixed. This subject is thoroughly discussed after the fundamental principles such as essentials of value and elements which reduce value have been established. The chapters devoted to the purpose of the appraisal and the fixing of rates are unusually well treated as is the chapter on the value of a water right and of reservoir and watershed lands in which subject matter the author is regarded as one of our best known authorities. The tables which complete the closing chapter of the book give to the reader a practical working basis of units from which computations in rate-fixing may be made. This book, coming as it does, from one of our highest authorities, will take its place at once among the small group of best books at the disposal of the valuation engineer on the subject of rate-fixing.

NEW BULLETINS

A new geological map of the state of California has just been published by the State Mining Bureau under the direction of Fletcher Hamilton, State Mineralogist. The geological formations found in this state are shown in twenty-three colors and symbols. The new map is 50 by 60 inches.

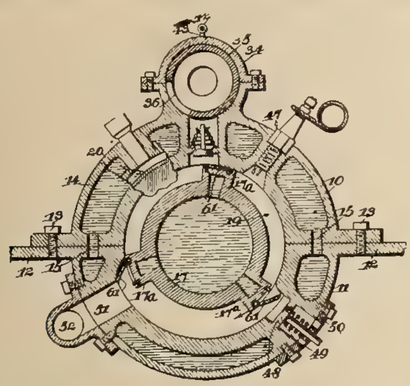
The analytical distillation of petroleum is the subject matter of Bulletin 125 just issued by the U. S. Bureau of Mines while Technical Paper 103 deals with physical and chemical properties of gasoline sold throughout the United States during the calendar year 1915. Bulletin 109 is entitled Operating Details of Gas Producers.

WHAT WESTERN INVENTORS ARE DOING

(Since the explosive engine is historically the grand-parent of the modern gas engine, it is of interest to note in this issue that a Western engineer has recently patented an engine of this type. The fly-catcher, too, seems to have been at work, and engineering camps may perhaps be more sanitary in future from the result of this invention. Other patents are also briefly described.—The Editor.)

1,212,914. **Explosion-Engine.** Mark S. Darling, Conrad, Mont.

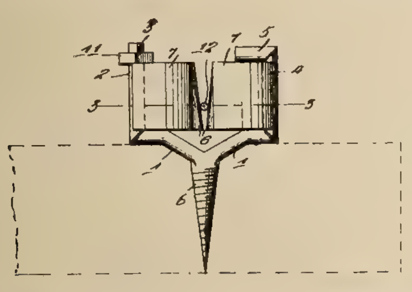
An engine, a stator, a gas receiving tank connected therewith, a rotor mounted in said stator and forming therewith a plurality of explosion chambers, said stator having gas outlet



ports connecting said chambers with the interior of said tank, and normally closed valves for controlling the passage of gas through the ports and opened by the force of the explosion in the chamber.

1,212,547. **Automatic Insulator.** Rufus A. Parent, South Tacoma, Wash.

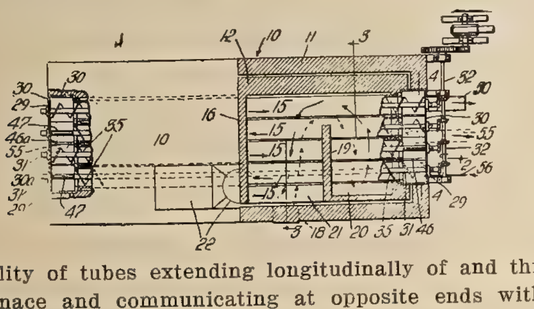
An insulator of the class described, comprising a plurality of blocks, means for supporting the blocks, wedging ribs formed upon the inner faces of the blocks, the ribs being en-



larged at their lower portions and tapering toward their outer portions, thereby providing an enlarged entrance therebetween, whereby a wire may be passed between the ribs until the same becomes wedged, thereby causing the wire to be efficiently supported by the blocks.

1,212,579. **Distilling Apparatus for Kelp and the Like.** John C. W. Stanley, Santa Cruz, Cal.

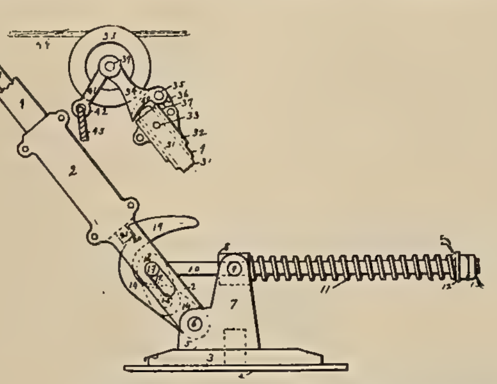
An apparatus for destructive distillation, the combination of a furnace, boxes arranged one at each end of the furnace,



a plurality of tubes extending longitudinally of and through the furnace and communicating at opposite ends with the boxes, means to move material back and forth through the tubes between the boxes, means to introduce material to be distilled into one of the boxes at the end of one of the tubes, means to discharge solid material from one of the boxes at the end of another of the tubes, and means to discharge gases from the boxes, the boxes having transverse partitions separating the points of communication of the several tubes with the boxes, and the boxes being open above the partitions to allow free passage of gases.

1,212,326. **Trolley-Pole Controlling Device.** Edward Albert Colton, Galesburg, Ill.

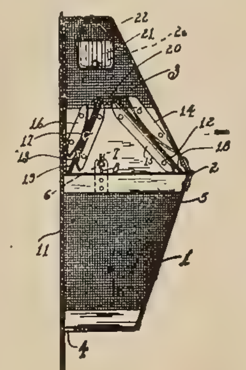
A trolley pole controlling device, an erector spring, a support for sustaining the tension of said spring consisting of a toggle joint one member of which is extended beyond



the knuckle of the toggle and forms a lever for supporting the weight of said knuckle caused by the tension of said erector spring; and means for retaining said supporting lever in its operative relation.

1,212,407. **Fly-Exterminator.** Nathanial Schultz, Stockton, Cal.

A device of the character described comprising two cage sections hinged together in inverted relation to each other, the lower section having an entrance opening opposite the



hinged end, the upper section being provided with removably inclined slides spaced apart at their upper ends to form an entrance from the lower section to the upper section, such slides being arranged to be removed when the lower section is opened on its hinges to allow the upper section to be cleaned.

NEW ELECTRICAL DEVELOPMENTS

(The most important new electrical developments of the past two week period lie. in the direction of the formation of large irrigation districts throughout practically every section of the West. In many instances electrical energy will simply be used to furnish householders with illumination and domestic service, while in still others electrical pumping is to be used on a wholesale scale. Other items of interest follow in the notes below.—The Editor.)

FINANCIAL

SEATTLE, WASH.—The municipal street railway lines of Seattle were operated during 1916 at a loss of $40,583, according to the statement of the city's public utilities department. Total operating expenses, including interest on bonded debt, was $87,042, and operating revenues amounted to $46,459.

SAN FRANCISCO, CAL.—Brisk deposits of United Rail roads 4s with the Union Trust Company and its Eastern correspondents have been the most striking characteristic of recent happenings in the local financial field. The holders of these securities are hastening to take advantage of the reorganization plan, propounded by the local committee, before it is too late. Over $10,102,000 of these bonds have been deposited.

PETALUMA, CAL.—The Petaluma Power & Water Company has elected as directors A. B. Hill, Dr. Thomas Maclay, F. D. Ellsworth, R. M. Hill and Frank P. Doyle, the latter of Santa Rosa. The new board of directors organized by electing the following officers: President, A. B. Hill; vice president, Thomas Maclay; secretary and superintendent, F. D. Ellsworth; treasurer, Swiss American Bank; accountant, Jesse Norman.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has sold to the National City Company and Harris, Forbes & Co. $3,060,000 general and refunding 5 per cent bonds, which will be offered to yield 5.45 per cent. Proceeds of the issue go to pay for the Oro Electric Corporation properties, for funds advanced to pay off underlying bonds and for extensions and improvements. The Western States, a subsidiary of the Standard Gas & Electric Company, has sold to H. M. Byllesby & Co. and Wm. P. Bonbright & Co, $1,564,000 10 year 6 per cent notes. The notes are part of a new issue, approval of which has been asked from the California Railroad Commission, and the proceeds will go to pay floating debt and for extensions and additions to properties.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the California-Oregon Power Company the directors were re-elected as follows: W. J. Brobck, Jesse W. Churchill, C. de Guige, Joseph Hyman, A. Donohoe, J. D. Grant, A. S. Holmes, John D. McKee, J. Henry Meyer and Alex J. Rosborough. The directors organized by electing the following officers: J. D. Grant, president; John D. McKee, Alex J. Rosborough and Jesse W. Churchill, vice-presidents; Paul B. McKee, assistant to president; J. C. Thompson, secretary; F. O. Cooke, assistant secretary. The executive committee consists of Jesse W. Churchill, Jos. A. Donohoe, J. D. Grant, Jos. Hyman, John D. McKee, J. Henry Meyer and A. J. Rosborough. The following financial statement for 1916 was exhibited:

Gross earnings	$421,886
Operating and maintenance	209,459
Net earnings	$212,427

The management reported that the installation of the first unit of the company's new power plant at Copco, on the Klamath River, would be completed by next summer. A second unit will be installed when needed.

INCORPORATIONS

PHOENIX, ARIZ.—Hydro-Power & Irrigation Company, Phoenix, Arizona, $1,000,000, by L. L. Osborn, Frank Putzell and R. W. Osborn.

PHOENIX, ARIZ.—Articles of incorporation have been filed by the Bertram Electric Company. Incorporators are H. P. DeMund and F. C. Hoeppner, both of Phoenix. Capital, $50,000.

SAN FRANCISCO, CAL.—Western Gas & Power Company of San Francisco, Cal.; $1,000,000; shares $100 each; subscribed 500, by C. S. S. Forney, B. F. Silverstein, E. J. Schultze, E. C. Hall and J. C. Wheeler.

ILLUMINATION

MARTINEZ, CAL.—Within a few weeks the Pacific Gas & Electric Company will begin installation in Martinez of an entire new street lighting system.

SANTA ROSA, CAL.—The city council will receive bids on the installation of the new electroliers and for furnishing lights for them. The style proposed for the two systems is "stagger type."

NEW CASTLE, CAL.—The supervisors have awarded the Pacific Gas & Electric Company the 5 year contract for lighting the Newcastle Lighting District, and it is stated that the system is to be rebuilt.

CHICO, CAL.—Nearly 70 per cent of the frontage necessary for the installation of the electrolier system by private contract has been signed by W. H. Gribble of the Western Gas & Electric Appliance Company.

WATTS, CAL.—The city has called for bids for the construction and installation of ornamental electroliers along both sides of Rosella avenue from the south line of Shorb avenue to the north line of Main street.

WATTS, CAL.—At a meeting of the board of city trustees bids for the lighting of Melvin avenue by construction of ornamental electroliers were received and the contract awarded to the California-Arizona Construction Co.

WATTS, CAL.—Bids have been called for the construction and installation of ornamental electroliers along both sides of Albert street from the east line of Electric boulevard to the west line of Palm avenue.

BURBANK, CAL.—Bids for ornamental street lights have been received by the city council. The lights are for San Fernando road. The contract has been awarded to the California-Arizona Construction Company on its bid of $6571.

CHICO, CAL.—According to an announcement made by Dennis Murphy, owner of a power plant site on Deer Creek, he will appear before the next meeting of the Business Men's Association to renew his proposal for a municipal lighting system for Chico.

SANTA MONICA, CAL.—A petition asking for the construction of a concrete sea-wall and walk with lighting posts of the same material, along the frontage of lots A to G, in Ocean Strand tract, has been presented to the board of trustees of Venice.

WINSLOW, ARIZ.—The city council has appointed a special committee to investigate the cost of installing gas lights on the street, probably with the idea that if the cost

is less than the present electric lights, gas will be substituted for electricity.

SANTA BARBARA, CAL.—Completion of the State street lighting system before the military encampment opens in June is one of the aims of the city council. Bids for the installation of ornamental lights will be received at the next meeting of the city council.

WATTS, CAL.—The board of trustees has awarded the contract for the improvement of Melvin avenue, from Shorb avenue to Main street, by installation and equipment of ornamental electroliers, to the California-Arizona Construction Company, on a bid of $60 per post.

TACOMA, WASH.—Bids are being received by the commissioner of light and water, H. F. Gronen, for $20,000 worth of incandescent lamps, to be delivered f.o.b. Tacoma within one year, and in such quantities as may be ordered from time to time by the commissioner of light and water.

SALINAS, CAL.—Electrical Engineer C. T. Phillips, Pacific Building, San Francisco, is completing plans for the electrolier system to be constructed in the city of Salinas, Monterey County. The plans call for a total of 65 ornamental electroliers, besides a concrete substation and underground conduit system. Bids will be called for shortly.

LOS ANGELES, CAL.—With the object of taking over the special street lighting lines of the Los Angeles Gas & Electric Corporation, the Board of Public Service Commissioners have decided to ask the corporation to reopen negotiations. If no satisfaction along this line can be gained, proceedings will be commenced before the State Board of Railway Comissioners for the condemnation of the lines.

LOS ANGELES, CAL.—The estimated cost of the new lighting system planned for Broadway by W. D'A. Ryan will be between $80,000 and $85,000. The Broadway Improvement Association will at once begin the circulation of petitions asking the city council to install the new ornamental system, which will increase the candle-power of street lights more than sevenfold, but will reduce the number of light globes by more than one-half.

MONTEBELLO, CAL.—Application has been made to the board of city trustees of Monterey Park by the Southern Counties Gas Company of California for a franchise right for a period of 50 years to lay and maintain pipes, pipe lines, mains, etc., under and along certain public highways, streets, etc., and to operate such pipes, etc., for carrying and distributing gas to be used for heat, light, etc. Bids will be received for said franchise up to March 10th.

OROVILLE, CAL.—According to statements by Mayor C. E. Kusel and City Trustee E. W. Fogg, at the next meeting of the city trustees, they will present a resolution asking the Railroad Commission to appraise and fix the valuation of the properties of the Oro Electric Corporation in Oroville. The appraisement will be asked as a basis for plans for a municipally-owned lighting system. The resolution is being prepared by Fogg, chairman of the water, light and power committee of the City Council.

TRANSMISSION.

SACRAMENTO, CAL.—State Purchasing Agent McMillin has awarded the contract to the Westinghouse Lamp Company for furnishing electric lamps to the state institutions.

LOS ANGELES, Cal.—An election on the proposed power bond issue of $12,000,000 and charter amendment to permit the city to buy the Southern California Edison and Pacific Light & Power distributing systems has been assigned for March 8th.

LEWISTON, IDAHO.—The committee of the Commercial Club, composed of Astor A. Seaborg, Robert S. Erb and Joseph E. Kincaid, advised the forming of an auxiliary organization with the object of promoting the erection of a power and storage dam.

HILLSBORO, ORE.—The Carnation Food Product Company has made provision to erect a new plant near the site of the old one. The building will be either of brick or tile and new boilers and a new "pan" will be installed, and the cost will be close to $75,000.

YUMA, ARIZ.—Yuma business interests using electric motors must buy new alternating current motors to take the place of direct current motors within thirty days, according to an announcement made by the Yuma Light, Gas & Water Company. New motors must be 220-volt, 3-phase and 60 cycles.

LOVELOCK, NEV.—Negotiations have been started by the Louisiana Consolidated Mining Company for the construction of a power line to the old camp of Tybo. This line will be installed by the Nevada-California Company by building from Belmont. This will entail an outlay of $30,000 and cover a distance of about 29 miles.

LOS ANGELES, CAL.—Twenty thousand signatures are now affixed to the initiative petitions asking the city council to adopt an ordinance providing for immediate sale of aqueduct power at wholesale rates to companies distributing electrical power who may wish to purchase such power. This makes certain the placing of the initiative ordinance on the ballot at the election on March 8th.

GRANGEVILLE, IDAHO.—Superintendent T. A. Bayless of the Grangeville Electric Light & Power Company stated that the company had decided that a new system would have to be adopted at the power site to insure good service. It has been decided to build a solid concrete dam across the Clearwater River 375 ft. long and 55 ft. high, capable of generating 10,000 h.p. The estimated cost of this dam will be from $40,000 to $60,000.

SAN DIEGO, CAL.—That improvements and extensions to the local plant of the San Diego Consolidated Gas & Electric Company costing about $25,000 will be made immediately, was the statement of L. A. Wright, Jr., of the commercial department of the company. Between $15,000 and $20,000 will be expended, it is stated, on the plant of the Escondido Utilities Company, which has been recently taken over by the company and $5000 more will be expended in rebuilding the street lighting system. High tension lines will be built into Escondido by way of Vista and Oceanside.

TRANSPORTATION

VANCOUVER, WASH.—The city council has granted a franchise to the Portland Railway, Light & Power Company on Main and Washington streets, for laying of both standard and narrow gauge tracks, or a three rail track accommodating standard and narrow gauge cars.

LINDSAY, CAL.—The options on various strips of land through orange groves held by the Visalia Electric Company for the proposed route into Lindsay from a point a mile east of the city has expired, but an extension was granted by the owners until such time as the Railroad Commission passes on the objection raised by the Santa Fe in opposition to the electric road crossing its yards.

TELEPHONE AND TELEGRAPH

UKIAH, CAL.—The supervisors have granted a permit for the erection of a private telephone line on the Willits road in the third district.

NOVATO, CAL.—The Novato Utilities Company has been granted a franchise to construct and maintain telephone lines upon the streets of Novato.

BOWIE, ARIZ.—R. D. Lincoln of the Mt. States Telephone Company states that the company will shortly construct a new line through Bowie and otherwise improve and modernize the service.

POMONA, CAL.—The contract for the new $25,000 building for the Pomona Valley Telephone & Telegraph Company

has been let to John F. Blee of Los Angeles and work is expected to begin soon.

LAKEPORT, CAL.—The Lakeport and Blue Lakes Telephone Association, which comprises farmers' lines of this end of the county, is planning considerable improvements in its lines and service.

SOUTH PASADENA, CAL.—An ordinance has been adopted by the city trustees granting the consent of the city to the sale, transfer and assignment by the Home Telephone Company to the Southern California Telephone Company of conduits, poles, wires, etc., of the Home Telephone Company.

DOUGLAS, ARIZ.—While no amount has been specified to be expended in betterment and extension of the telephone service in this city, it has been announced that the Mt. States Telephone Company plans to extend its lines to keep up with the growth of the city and give adequate service.

LAS VEGAS, N. M.—The Onava Telephone Company has been organized by a number of residents of the Hart Tract. A telephone line is to be built about ten miles in length and the company expects to make arrangements to connect with the line of the Mt. States Telephone Company. The officers of the new company are H. A. Richert, president; D. H. Kunkle, secretary; O. B. Underwood, treasurer.

IRRIGATION

OROVILLE, CAL.—The first steps toward the establishment of a mutual water system for the irrigation of thousands of acres of land southwest of Oroville, have been taken by the Western Canal Company.

PORTERVILLE, CAL.—Officials of the Lindsay-Strathmore Irrigation District have made a formal filing with the water commissioner of the state of a request for the diversion of 8000 ft. of water from North Tule River.

CHANDLER, ARIZ.—Edward R. Jeffrey of Los Angeles has purchased 640 acres of desert land. He will proceed to improve the property by installing two 1500 gallon pumps. All of the land will be put under cultivation and a large part planted to cotton.

KEYSTONE, WASH.—The Keystone Irrigation District of Keystone, Wash., voted bonds on January 26th in the amount of $200,000 to construct a pumping plant and irrigation works to serve 5000 acres of land fifty miles southwest of Spokane on the main line of the Northern Pacific. R. T. Stone is secretary-treasurer of the district.

ALLENSWORTH, CAL.—Negroes of Allensworth who comprise more than 90 per cent of the population of this district, in a meeting here adopted a preliminary plan for the formation of an irrigation district. They contemplate a system of deep wells with which to develop water sufficient to irrigate a tract of approximately 7000 acres.

GRANTS PASS, ORE.—With only five votes registered against it, the project for the formation of the South Side Irrigation District for the irrigation of 8000 acres of land on the south side of Rogue River, was carried recently. Charles Smith, G. A. Hamilton and C. C. Hamerly were elected directors of the new district, and George Dickinson, treasurer.

COLUSA, CAL.—The directors of the Cheney Slough Irrigation Company have let the contract for the construction of the Arnold lateral to C. A. Hische, who expects to finish the work in ten days. This lateral will irrigate the Holloway Cheney slough ranch, and parts of the Cheney, Fendt and Arnold ranches. The long dry spell has added to the interest in the rice industry and a large acreage will be planted this year.

SALT LAKE, UTAH.—The estimate of engineers concerning the probable cost of bringing water from the Gunnison reservoir to the ridge lands to irrigate the Juab Valley's dry farm area has been completed. It is estimated that the digging of the canal and all other work incident to the project will cost about $1,800,000. Adding the cost of the water, the total investment will be more than $2,000,000, figuring on 60,000 acre feet of water. The section to be benefited includes more than 30,000 acres.

PORTERVILLE, CAL.—S. E. Kieffer, engineer in chief for the Terra Bella district, is here from San Francisco in charge of the erection of well rigs, with which to drive a series of deep wells to supply water for the reclamation of more than 10,000 acres of citrus lands in the Deer Creek and Terra Bella districts.

VANCOUVER, WASH.—The Standard Electric Power & Chemical Company, with a capital stock of $4,000,000, was incorporated here recently by C. D. Charles and John A, Jeffrey, of Portland and D. F. Smith of this city. The object of the company is to develop water power sites on the Deschutes River, bring the power to Vancouver and establish a nitrate-producing plant in this city.

YUMA, ARIZ.—The Yuma Gas, Light & Water Company is going ahead in the improvement of its plant. About $20,000 worth of pipe has already been ordered for the new pipe line from the plant to the reservoir. The total cost of the improvement will be $30,000. Other improvements which the company has in view will carry the total expenditures which they will make on their plant up to approximately $75,000.

SAN FRANCISCO, CAL.—Charles W. and H. S. Landis, who are promoting a water project, designed to irrigate 100,000 acres of fertile undeveloped land in the southern part of Sacramento County and the northern part of San Joaquin County, are credited here with declaring that contracts for construction work may be entered into within 30 days. The lands to be irrigated lie between Lodi and Clements, east and west, and between Dry Creek on the north and the Mokelumne River on the south. The project will be known as the Dry Creek Irrigation District, or the Dry Creek-Mokelumne River Irrigation district.

In This Issue *Regenerative Equipment for Electric Railways, Multiple-Arched vs. Single-Arched Dams, together with Departmental Discussions of Vital Interest to Engineers of the West*

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A Monster Array of "Battleships," Electrically Drawn

AN UNUSUAL RAILWAY ELECTRIFICATION

BY A. H. BABCOCK

(The whole electrical industry is alert to the possibilities of regenerative applications in the operation of electrified lines. The splendid showing that is being made by the Chicago, Milwaukee & Puget Sound Railroad through the Northwest in saving of net power consumption and ease in operation auger well for the future possibilities of regenerative methods on all transcontinental lines of the West. Here is an article, descriptive of a well-known Eastern electrification, by a Western authority on electric railway problems that, coming at this time, will undoubtedly be of intense interest to engineers of the West. The author is consulting electrical engineer for the Southern Pacific Company and delivered this paper before a recent meeting of the San Francisco Section of the American Institute of Electrical Engineers.—The Editor.)

The Master Controller

THE Norfolk & Western Railway Company covers 2050 miles of line extending from Norfolk, Va., through Roanoke and the Pocahontas coal fields, W. Va., to Columbus, O., with principal branches to Cincinnati, Bristol, Tenn., and Hagerstown, Md. The main line is double track.

In the fall of 1896 the property resumed operation, after an 18 months' receivership. This fact is stated to emphasize the point that, while at present the property is in a most satisfactory financial condition, under an exceedingly capable management, and is now noted for its progressive developments in all lines, these conditions have not been enjoyed from the first, and therefore its remarkable achievements in the past few years are altogether more noteworthy. For example, in the fiscal year ending June 30, 1915, a decrease in total operating revenue of 3.73 per cent of the year before was converted into an increase in net revenue from railway operations of 4.41 per cent, with an increase of 14.49 per cent in maintenance of way expenditures and a reduction of nearly 25 per cent in the number of cars and locomotives awaiting repairs. Ninety three per cent of its decrease in revenues was offset by a reduction in transportation expenses, and at the same time the operating ratio was reduced from 67.49 per cent to 64.74 per cent. An even more unusual showing was made during the last fall and winter, where the operating revenues were increased 37 per cent over those of the year before; the net operating revenue increased 69 per cent, and the net income was increased 96 per cent. During these months an increase of 37 per cent in freight traffic was handled, with only a 10 per cent increase in transportation expenses; and the operating ratio was re-

duced from 66 per cent of the year before to 56.9 per cent. These figures, truly remarkable, are an index of the character of the present management.

It should be remembered that the Norfolk & Western was the first road to adopt the Mallet type of locomotive for general road service on low grade lines. In 1913 it placed in operation at Norfolk the largest steel coal pier on the Atlantic seaboard; and this road was the first to use 100-ton capacity cars in coal service. Detailed mention of the steel coal pier and the large coal cars will be made later.

Traffic.—The N. & W. is primarily a coal-carrying road. Over 85 per cent of its revenue is derived from freight as compared with 11 per cent from passenger traffic; and of the freight traffic approximately 71 per cent consists of bituminous coal, all of which originates between Graham, Va., and Williamson, W. Va., a distance of 104 miles, on which the road has a complete traffic monopoly. In this district about 2000 cars of coal and 100 carloads of coke are produced daily, by 214 mines and more than 2000 coke ovens. The largest individual area is the Pocahontas field, extending from Graham to Welch, 27 miles. This field includes 86 mines, the output of which is about 62 per cent of the total coal tonnage of the road. About 250 carloads a day go west to Columbus for movement over the Lakes via Toledo and for rail distribution through the Central West. The remainder goes east to tidewater or to points along the line for delivery to connecting lines. Even at the present extraordinary rate of production, geologists estimate that there still remain in the fields immediately tributary to these lines over 5,000 million tons of coal, or approximately 100 years' supply. In addition to this very large coal tonnage, the road handles a heavy merchandise and time freight traffic. About five time freight trains are loaded daily at Norfolk with merchandise coming by water from Eastern points and billed to Southern and Western points.


The Electric Passenger Train in Operation

Omitting for the moment a consideration of the very steep grades in the electrified zone, the remainder of the line has a ruling 0.3 per cent grade from the coal fields west to Columbus, and, with a single exception 0.5 per cent from the coal fields east to tidewater.

One Hundred Ton Car and New Coal Pier.—The coal pier and the 100-ton coal cars are a unique combination. The cars (colloquially known as "battleships") are steel gondolas of external dimensions very closely approximating a large box car. They are loaded in the coal fields by chutes from the coal breakers. At the end of their 400-mile run to tidewater they are put into a frame and capsized bodily to dump their contents into coal bunkers located in the new pier at which a 5000-ton cargo steamer is loaded in two hours.

Electrified Section.—Is that part of the Pocahontas division between Bluefield and West Forks, a distance of 29.4 miles, all of which is double track with long middle passing tracks, excepting through the Elkhorn Tunnel, where the line is single track for a distance of 3100 feet.

The grades against eastbound traffic are 1.5 and 2 per cent, with a maximum curvature of 12 degrees. Sixty per cent of the entire zone is on curves and at only two points in the zone is it possible to see the caboose from the locomotive of the ordinary freight train.

The train service consists in gathering the coal tonnage at the mine and delivering it to the storage yards. Since about 2000 carloads of coal originate daily in this very limited territory, to keep the mines in this vicinity supplied with empties and to remove the loads without delay and congestion requires a very careful organization. Possibly a brief description of a trip of this kind may give the best idea of the operating methods. The following is taken from my notes: 11:30 a.m. left Bluefield with 88 empties and after about an hour continuous run, stopped to begin to set them out. At this point a pusher set in ahead of the caboose, and for the rest of the trip was used to set out cars at the various sidings wherever these sidings could not be reached from the head end—that is, the road engine handled only those cars set out from the head end. At the west end of the electrified zone we had dropped all our empties and there picked up a 3250-ton train which we handled alone until reaching the summit helper grade, where a pusher was added. At the summit we dropped the pusher, took the train to Flat Top yard, where it was made up to 5000 tons, and with the help of a pusher we took this load to Bluefield. This trip represents very fairly the ordinary service.

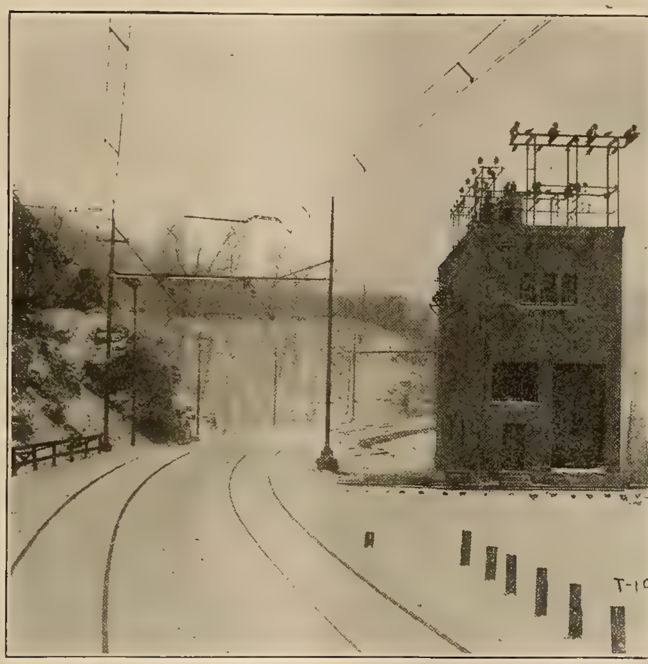
The general routine of handling the engines and engine crews is about as follows: One motor with its engine crews makes two round trips per day. On pusher service a motor makes five trips pushing eastbound over the Elkhorn grade and also helps distribute empties on the westbound trips. Under steam conditions two Mallets and two engine crews made one round trip per day, and one Mallet pusher on the Elkhorn grade made three trips per day, handling the same tonnage.

Train Consist.—Full tonnage eastbound trains are handled by two motors, one at the head end and one pushing. Manifest freights use one motor pushing to assist the steam road engine. Heavy passenger trains with steam road engine have one motor helper.

The day's work runs about as follows—freight business only:

August 1st—Eastbound, 8 crews made 16 trips with 581 loads, no empties; total tonnage, 51,501. Westbound, 150 loads, 361 empties.
The Elkhorn pushers, with four crews, made 18 helper trips, and the Flat Top pushers, with one crew, made 8 helper trips.
August 9th—Eastbound, 8 crews made 16 trips with 621 loads and no empties; tonnage, 51,849. Westbound, 109 loads, 320 empties.
Elkhorn pushers, 4 crews, made 19 trips.
Flat Top pushers, 2 crews, made 15 trips.
August 19th—Eastbound; total tonnage, 59,291. Westbound 171 loads, 744 empties.
Elkhorn pushers, 4 crews, made 20 trips.
Flat Top pushers, 1 crew, made 6 trips.
An extremely light day is illustrated by August 20th: 3 crews made 6 trips, 149 loads, 126 empties; total tonnage 15,857. Westbound, 33 loads, 427 empties.
Elkhorn pushers, 4 crews, made 16 trips.
Flat Top pushers, 1 crew, made 6 trips.

The real test is the annual tonnage. Eastbound freight alone is given because it is the controlling movement; the westbound tonnage is not counted because movements in that direction cannot be fully loaded. The steam service was run exclusively up to February 10, 1915; mixed, until April 14th, and full electric tonnage thereafter.


A Substation Showing Typical Line Connections

During the year 1914 and the first four months of 1915, the average trains per month was 290 and the average tonnage per month, 852,750. For the eight months, May to December, 1915—namely, the first months of all electric service—the average trains per month was 367.75 and the average tons per month, 1,135,181. Similarly for the year 1916, January to July, (my visit was in August), the average trains per month were 412.29 and the average tons per month, 1,141,402. Averages sometimes are deceiving, but it is significant to note that the average tons per train over the first period, that is to say, before electrification, was 2250, and for the few months after electrification the average was 3090, and for the first six months of the present year was 2735. The difference between the averages for 1915 and those of 1916 may be accounted for in the accident that occurred last spring, whereby for a very considerable period the station capacity was reduced to one electric train with one pusher. It is safe to say that the average train loading has been increased very approximately 33 per cent, and the average train movements, practically the same amount; in other words, the track capacity has been very nearly doubled.

Electric System.—The power house generates 25 cycle alternating current at 11,000 volts, which is stepped up to 44,000 for distribution to the substations, where it is stepped down to 11,000 and fed to the contact wires. On the locomotives it is converted and transformed to three-phase current at 725 volts, delta, by means of a split phase converter. The locomotive motors are wound for three-phase current controlled by liquid rheostats. The power station is located at Bluestone, which is 11 miles west of the east end of the electric zone. The station location was fixed by considerations governing the economic production of power. The power house has been described so many times in the technical press that detailed descriptions are not necessary. It is well to note, however, that the inherent simplicity of the single-phase distribution, combined with the skill of the designing engineers, have produced an installation well worth careful study by those who have to do with such designing.

An unusual feature of the station is the regenerative load rheostat equipment, operated automatically by a group of relays, magnetic switches, current transformers, etc., so connected that when the power regenerated by the locomotives and returned to the power house is in excess of the demands on the station, these water rheostats will cut in successively to absorb the excess load and prevent the reversing and motoring of the generators. Conversely, when the excess regenerated power is reduced to zero and only one rheostat is in service,—which means that all of the rheostat load is supplied by the generators,—the rheostat is automatically cut out, and when with two rheostats in service and the excess regenerated power drops to 200 k.v.a., one rheostat is automatically cut out while the other remains in service until the excess regenerated power drops to zero, when this cuts out automatically, as before.

The water rheostats were installed originally in the intake of the circulating canal; the movable electrode was a steel cone suspended over a six-inch iron plate located in the bottom of the canal and grounded to a copper plate imbedded in the earth outside of the canal. The rheostat was adjusted by varying the distance between the cone and the iron plate, and the ground outside of the canal prevented electrolytic damage to the concrete. After the road had been operating a few months, an improved type of rheostat was developed and is being used in place of the original. Three boxes 15 ft. long, 2 ft. square in section, were mounted on 44,000 volt pin insulators. These boxes are placed 4 ft. between centers on the ground and are connected in parallel for adequate carrying capacity. At one end,

fresh water is fed through Orangeburg fibre conduit, which is mounted on 11,000 volt pin insulators, and it flows out through numerous holes on the opposite end. Uniform velocity of waterflow throughout the entire section of the box is secured by using smaller holes at the bottom (where the pressure is greater).

The electrodes are 5-inch channel irons, 15 inches long, hung from suspension type insulators. The high pressure end is connected by 11,000 volt overhead leads with the power station, and the grounded electrodes are connected to the ground plate. Whatever adjustment of resistance is necessary to compensate for the varying conductivity of the water in different seasons of the year is obtained by shifting the electrodes horizontally in the boxes; and by reason of the small cross-section of the boxes, all necessary adjustment can be made without difficulty.

Five step-down transformer substations are installed at intervals along the line, in which are located single-phase, oil-insulated, water-cooled type transformers operating without station attendance, the necessary switching being handled by the regular railroad attendants at passenger stations, yard masters' offices, etc.

Transmission and Distribution System.—The transmission lines are two single-phase circuits using four 2/0 7-strand hard-drawn copper wires mounted on pin type insulators supported on catenary structure, except where the transmission line on wooden poles, passes over the tunnels. A ⅜-inch steel ground wire is carried above the transmission lines over the length of the line. The cross-arms on all poles are connected to the ground wire, which itself is grounded every 1200 ft. At the substations the high tension lines are sectionalized by means of air break switches located on the roofs. No supplementary feeders are necessary for the distribution system, the power supply being effected entirely by means of the contact lines. Two distinct types of supporting structures are used—namely, on the main line, light bridges made generally of tubular steel poles (guyed wherever necessary) set in concrete, which carry light steel "H" beams from which the catenary structure is suspended. Across the yards the catenary is supended from an overhead cross catenary cable strung from high poles or towers located at opposite sides of the yard. On tangents the bridges are not guyed, but in all curves guys are installed on the outside of the curves wherever there is room on the right-of-way. An unusual feature of the bridges is the use of the sag bracing instead of knee—a feature that adds to the available clearance under the beam, without increased height of the poles because of the feeder system for which the poles necessarily are designed. Ordinarily, the bridges are set 300 ft. apart on tangents, the spacing being reduced on curves in the usual manner. The contact wire is number 3/0 grooved phono-electric carried 24 ft. above the rail tops, with a maximum horizontal variation of 12 in. at the center of the track both ways, due allowance being made for the super-elevation.

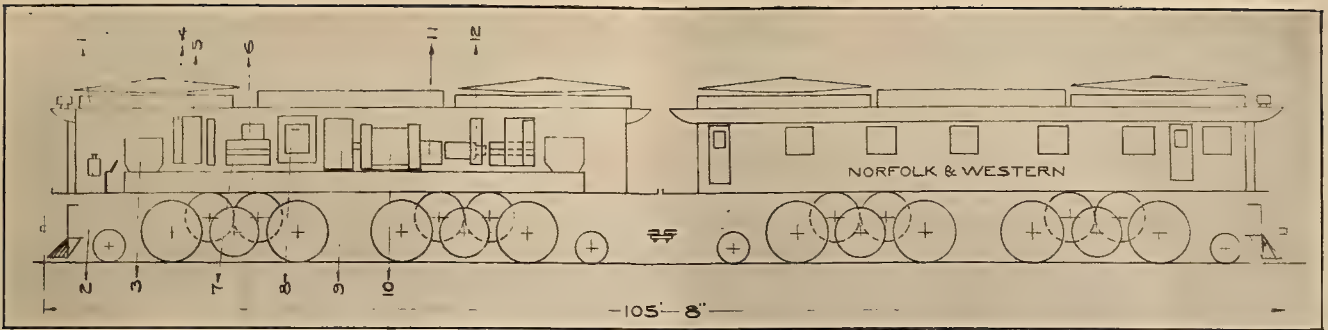
The overhead construction is exceedingly simple. On tangents a steel casting attached to the horizontal beam, supports three suspension type insulators, any one of which is good for the working voltage of the line. From the bottom of the lower element a malleable iron casting is suspended that clamps to the messenger wire. The latter is a ½-in. extra high tension galvanized steel cable, and from it at 30 ft. intervals the hanger straps are suspended, from the lower ends of which are hung the auxiliary messenger wire, which is number nought round copper on steel. The contact wire is clipped to the messenger wire at 15 ft. intervals, so spaced that they are equally distant from the hangers that support the auxiliary messenger wire; a construction that altogether makes for a very flexible and smooth running contact.

The temperature variations on this line are severe, in consequence of which the structure is stressed, at times, up to the elastic limit. The liberal use of steady strains on long tangents keeps the contact system in line. On curves, (it should be remembered that 60 per cent of the line is curves), the trolley wire is held within the horizontal limits above specified, by shifting the clamps along the beam. On sharp curves the use of pull-out poles designed with auxiliary messengers produces an effect well known to those familiar with a similar construction on the Oakland, Alameda and Berkeley lines.

In the long tunnel, special construction was necessary because of the steam and smoke emitted by those steam locomotives that are still used for economic reasons on trains running over the branch lines. The contact wires are supported every 75 ft. from 44,000 volt insulators on which are secured a cross pipe bent to follow the arch of the tunnel and from which the bronze messenger wires are supported. The construction is such that two 44,000-volt insulators are in series between the contact wire and the walls of the tunnel. On the branches and coal mine sidings, comparatively inexpensive wood pole bracket type construction is used.

The track bonding is unique in that a special construction permits a concealed type of bond to be installed with the removal of only one bolt per joint. The bond terminals are expanded in holes in the rail by means of the well known steel drift pin. One terminal is welded to one end of the bond, the free end being tinned to permit pushing the bond through under the angle bar and to facilitate soldering after the bond is so installed. Both terminals are then placed in the holes in the web, and drift pins driven.

Track transformers located at approximately one-mile intervals are installed to reduce inductive interference with the telephone and telegraph circuits. Personal tests on the different dispatching business circuits showed that these inductive troubles produce less effect than in the case of most long-distance transmission power company circuits of which I have any knowledge. Experience on this line shows that interference under ordinary working conditions can be reduced to the negligible point. With a short circuit on the transmission or contact system, however, the results are as heretofore—namely, a practical paralysis of the telephone systems for the time being. Experience here indicates that probably the best results can be obtained in such installations by a short distance between feeding points and by feeding both ways, avoiding stub and feeds. That these disturbances are of little practical moment is demonstrated in the exclusive use of the telephone for train dispatch-



The Complete Electric Locomotive with Same Apparatus in Both Halves

ing purposes. Furthermore, the company maintains a private telephone system for the transaction of business over its entire line.

Locomotives.—The locomotives have been described so many times in the technical press that a detailed description here is hardly warranted. Furthermore, we are more concerned at present with the performance of these machines than with the details of their construction. It is well, however, to note some unusual features of their construction.

Each unit consists of two parts, practically identical. For convenience, the two halves will be considered separately. They have two main trucks connected by Mallet hinges, each truck being provided with two driving and one guiding axles. The trucks are then placed back to back so that the classification is 2-4-4-2. The driving wheels are 62 in. in diameter, and the guiding wheels are 30 in. The total weight on drivers is 220,000 lb., and the total weight of the unit, 270,000 lb. The length over all of the two units coupled together is 105 ft. 8 in. The rigid wheel-base is 11 ft., and the total wheel-base, 83 ft. 10 in. The driving motors, of which four are mounted in each unit, are 3-phase, adjustable speed type. The maximum accelerating tractive effort of the locomotive (two units) is 125,000 lb.; the one-hour tractive effort, 87,000, and the continuous, 68,000 lb.

The operating conditions on this line are in many respects closely similar to those on the Sierra Nevada and Tehachapi grades, where, owing to the length of the train and the difficulty in signaling from one end of the train to the other when the pusher is used, it is not at all unusual for it to stand at full tractive effort for a minute or more before the road engine has pulled out enough slack so that the pusher can move. Conversely, when a train is coming to a stop on an adverse grade, the road engine shuts off and applies the brakes, while the pusher keeps moving until the bunching of the cars ahead of it brings it to a standstill. The result of these motor characteristics is an extremely easy, smooth handling of the train under such very severe conditions.

The liquid rheostats permit an adjustment of the load of the individual motors, so that the engineman, by watching his ammeters, can develop the maximum tractive effort of the machine without danger of burn-out of any part of the equipment. This sort of control is a very great advantage in handling a train on a heavy grade with bad rail, it being possible, under these conditions, to load all motors right up to the slipping point, regardless of variation in diameter of driving wheels or of the condition of the particular piece of track on which the unit may be standing momentarily.

The maintenance of these machines in road service conditions is taken care of at the inspection shop at the east end of the line. Once a day they go over the pit, where the usual mechanical adjustments are made, that is, taking up the slack in the brake rigging, inspection of contactors, etc., up to, but not including, dropping out of the wheels, for which they go once a week to the general shop. Not more than 40 minutes are allowed at the inspection pit. The cabs are interchangeable, so that in case of trouble the maximum number of units can be kept on the track.

The machines average about 80 miles a day, which means practically two round trips across the electric zone, plus switching as may be required. These two trips constitute a day's work for the crew. Up to the time of my visit, with the exception of some locomotives damaged in collision, none of the machines had been into the general shop for more serious work than relining of wedges, dropping of wheels,—which normally keeps the machine out of service about one week.

The force at the inspection pit consists of one inspector, one machinist, one wire-man, one oiler, and two laborers.

The ease of control of a train with these machines is simply amazing; one of the principal difficulties a man has in operating on this district is to keep awake. The constant speed, both up hill and down, the droning sound from the motors, and the absence of apparatus that demands constant attention, all combine to put the most active man into a somnolent condition; as a matter of fact, two trains got together one night simply because one man was sound asleep and the other man was unable to back his train uphill, out of the way. After the train is once in motion, there is nothing to do but to watch for signals.

Much public notice has been taken of the regenerative control, which is handled about as follows: As the engine passes the summit, the engineman watches the ammeter, and when the current begins to drop, he shuts off at the controller and throws the regenerating switch; then opens the controller to running position. In a few seconds the current builds up to three or four hundred amperes and the train is at synchronous speed, plus the slip; in other words, the train travels uphill at synchronous speed minus the slip, and down hill, at synchronous speed plus the slip. It is difficult for one accustomed to the necessarily rough handling of long freight trains on steep grades, to

refrain from extravagant language when commenting on the remarkably smooth handling of these very heavy trains by electric motors plus regenerative braking. The starts are made as easily as the O. A. & B. trains and without jerking out the slack. The braking is even more to be praised. It was my observation that even up to 90 cars the train came to its stops without perceptible jar anywhere. Furthermore, while setting out empties from the head end it

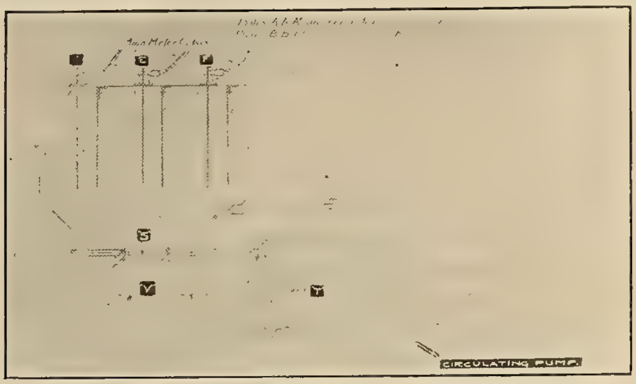


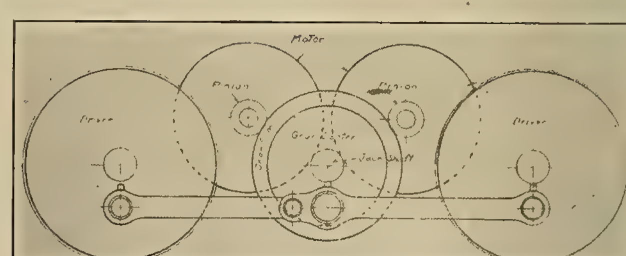
Diagram of Water Rheostat for Regenerative Equipment

was impossible for me to determine without looking back, whether the engine was working light, or with only a few cars, or was starting the whole train. When regenerating on the heaviest grades, if for any reason the air has to be used, the orders are to brake to the bottom of the grade by air alone. The reason is that a considerable time interval is required to change the phase converter connections after synchronous speed is reached, and they fear losing control of the train in this interval, because acceleration on these grades is so rapid that in a few seconds the train would reach a speed high enough to cause the wheels to slide back to synchronous speed, at which point regenerative braking is impossible. In the early days of electric operations, attempts were made to brake jointly by air and motor, but there resulted very heavy shocks to the train and practice had to be abandoned. My notes record that on one of the trips the current regenerated on the heavy grade on the east side of the Elkhorn tunnel was just about the same as that taken by the motors in pulling up the west side of the same grade, which means, of course, that a train going down the east side would very nearly supply the total power needed to pull a corresponding train up the west side; the difference being due to the double losses in the two sets of transformation. Current readings do not give any measure of the actual power taken or returned, for the reason that the power factor varies; for example, I have notes that, with the motor pulling the train down a slight grade, practically the same current was taken as when regenerating on the heaviest grades. My notes give 6300 k.v.a. and upward regenerated during the first part of the heaviest grades after leaving the tunnel, which dropped off quickly to 1600 and down as low as 800 as the train speed was reduced. Probably not more than 25 per cent of the regenerated energy gets back to the power house. This is indicated by the fact that the graphic charts at the station show very few drops below the zero line, which means, of course, that the regenerating rheostats are seldom used. The station power factor is approximately one-half, and the local factors are as follows: On the 5-minute basis, 0.3; on the 15-minute, 0.35, and on the 60-minute, 0.5. These figures are considered merely a good, fair average.

With eight locomotives in service, probably not more than three trains would be on the track, under maximum conditions; the power house loads then show about 6000 kilowatts per train on the grade, going up to between nine and ten thousand for one minute, while accelerating; and the average over the whole line is approximately 4000 kilowatts.

Some criticism of the constant speed feature of operation has been made by steam railroad men who are not conversant with the results thereof. The train dispatchers speak most enthusiastically of this feature, which permits them to count on the arrival of a train at a given point within a fraction of a minute; consequently, their dispatching is rendered very much easier. As a result, any freight train is sent out on the line ahead of any passenger train whose schedule speed is not more than 15 miles per hour, and the passenger train is not held up. I came in on a very heavy eastbound train that actually was sent out on the line 20 minutes ahead of a passenger train, and we pulled into the Bluefield terminal in plenty of time to clear the passenger train. Such operating would be unheard of on the ordinary steam line.

The results of electric operation are most satisfactory. The general superintendent informed me that the largest saving was due to better handling of the traffic, in that lost motion is eliminated, no stops for fuel or water and to blow up steam, are necessary; therefore, the trainmen have less grounds for excuses for delays; hence there is a general tuning up of all hands. Under steam operation it was very difficult to realize more than 7 miles per hour schedule speed, while under electric operation they can count on 14, and, quite as important, they can count on handling full tonnage without loss of train speed. Last May, trouble in the power house cut down the electric loco-



Arrangement of Motor Jack Shaft and Driving Wheels on One Truck

motives available from six to two in service, of which only one could be used at a time, on the hill. As a result, 16 of the largest type Mallet steam engines had to be brought in from other divisions in order to maintain the traffic.

At the time of the inauguration of the electric operation 18 Mallets were assigned to the hill. These were rated at 1050 tons trailing load at 8 miles per hour; but the maximum that could be gotten out of them at 14 miles per hour was only 800 tons. Two

Mallets plus a pusher on the heaviest grades hauled the 3250 ton train, and the load from Flat Top in, using the two road engines, could be not greater than 4000 tons. All Mallets are now assigned to other divisions. On the basis of their former performance, the present traffic would require 24 Mallets, a traffic that is now handled easily by eight electrics, with occasionally one more; and the entire electrical equipment of the line consists of 12 locomotives.

As was stated previously, the result of all these improvements is a practical doubling of the capacity of the line over what it was under steam conditions, which in itself is a sufficient warrant for the expenditure of the four million dollars the electrification cost. It is significant, however, that the general manager of the line refused to give me any operating costs per ton-mile, because, as he said, such figures as were available would not be fair to electric operation.

Since the opening of traffic the trolley wire has been burned off once, due to inexperience under sleet conditions; two enginemen have been killed—both went on top of the locomotive cabs contrary to orders, and absentmindedly put themselves in contact with the trolley wire.

It is interesting to note that extensions that will materially increase the electrified track mileage of the electric zone are now planned. No new district will be electrified, but the present zone will be enlarged, by extending the electrification, westward, and by taking in some branches. The purpose is to get away from a certain amount of forward and backward train movement and to derive other substantial benefits that will come from a more complete electrification of this zone. No additional locomotives have been ordered to provide for the increased mileage of electrified track.

THE MULTIPLE-ARCHED vs. THE SINGLE-ARCHED DAM

BY JOHN S. EASTWOOD

(Sober consideration of the factors that enter into dam design since the great floods of 1916 and their consequent disaster is timely at this moment, when many additional projects of mammoth proportions are under consideration. The columns of the Journal are always open to proponents of various types of dam design, since only by consideration of all the factors that enter into an engineering problem can we hope ultimately to reach the goal of perfection in design. Nowhere in the world has dam design been carried to a higher pinnacle of success than here in our Western country, where men dare and make good in their efforts. The autthor of this article is the originator of the well-known type of dam known as the Eastwood multiple arch and as a consequence this comparative discussion is of unusual interest.—The Editor.)


A Multiple-Arched Dam Replacing One of Single-Arched Design.

THE Rankine Ring Formula has been used by most of the engineers who have designed and built arched dams, as the rule for the computation of the stresses set up in them. This formula has been used by some of them as though it were a universal formula that was applicable to all cases and by others it has been used as if it had little influence, and curvature has been introduced into the design of dams as though it had no influence on the stresses set up in them.

Some of them use it as the only factor in setting up stresses while others use it as though it did not particularly affect the stresses in the structure.

This formula is expressed as $T = pr$, in which expression T, is the tangential thrust set up by water pressure on a curved surface, p is the water pressure per unit of area, r is the radius of the curve of the surface pressed. If q is the allowable loading on a unit of area of the material of the arch ring and t is the required thickness to resist this pressure, $\frac{pr}{q} = t$.

This formula is applicable only when the conditions of loading are as expressed by its author, that of a case where a semi-cylinder of a linear arch under hydrostatic pressure supported by the other half equally loaded. The formula is then only strictly applicable to the above particular set of conditions and any departure from these conditions will cause a like departure of the applicability of the formula. The degree of departure from the stated conditions will influence the degree of the accuracy of the results obtained. Its universal application to all conditions will lead us far from the true results.

To illustrate its application by means of a series of arithmetical examples, we will assume to have been eliminated as many of the conditions as possible that limit its application; also, we will take the dimensions of our opening sufficiently large to accentuate the departure of the indicated results from the actual.

Let us assume an opening having a depth of 200 feet and a width of span of 1000 feet. This opening we will assume to be closed by means of a single-arched dam, free to move on a frictionless base and having hinges or voussoirs to remove the reactions due to rib shortening reactions. To this ideal dam let us apply the Rankine ring formula to determine its stresses and required base thickness, considering the bottom ring of one foot depth, the center of which is 200 feet below the surface of the water.

The water pressure on a unit of area, 1 square foot, or p, will be 6.25 tons; assume q, the safe loading as 300 lb. per sq. in. or 21.6 tons per sq. ft. in compression, and introducing varying radii, to ascertain the required base thickness of the arch ring.

Example 1. Angle of arc, 180°, giving radius of extrados of 500 feet. $500 \times 6.25 = 3125$ tons, tangential thrust, T, which divided by $21.6 = t$, the thickness required, or 144.68 feet.

Example 2. Angle of arc, 90°, radius, 707.1 ft. thrust 4419.4 tons, required thickness 204.6 ft.

Example 3. Angle of arc, 45°, radius, 1306-6 ft. thrust 8166.2 tons, thickness 378.1 ft.

Example 4. Angle of arc, 1°, radius 57296.0, thrust 358200.0 tons, thickness required, 1658.3 ft. or 12.67 times as thick as would be required for a straight gravity dam of same height.

The straight gravity section 200 feet high will require a base width of 130.93 feet. (see Weggman, plate XLLL).

Example 5. Angle of arc, 180°, for equal thickness of base, the limit of span will be 904 feet, for angle of arc of 133° 34′ were used, for equal thickness the span limit will be 831.0 feet. If an equal quantity of material were used, and economic arc of 133° 34′, used, the span limit will be 655 feet, in which case the stress in the single-arched dam would be 21.6 tons per square foot as against 17.8 tons in the gravity section. If we take equal stresses in each type, and the same arc of 133° 34′, the span limit will then be 539 feet for 17.8 tons.

If the Rankine ring formula is correct for all conditions, as the use of it by all of the engineers that have built single-arched dams would indicate, this type of dam to compete with the straight gravity dam, will only be economical for very narrow spans. Manifestly it is not true except when used in the sphere for which it was derived by its author, otherwise, some long radius dams would be taking more stress than if designed as straight gravity dams. Its departure from the truth as a means of arriving at the true stresses will depend on the departure of the conditions met in practice from those upon which the formula is based.

But the ideal conditions above mentioned do not exist in any natural opening, for here we have sloping sides, preventing the use of hinge joints, the base of the structure more or less rigidly attached to the foundations and sides, a constantly varying angle of arc and thickness of arch ring, a constantly varying consistency of abutments and foundations, a constantly varying upthrust under the foundations, and all of these singly or combined to vary the stresses in all parts of a single-arched dam.

As all of the so-called constant angle arched dams and all of the single-arched dams built by L. A. B. Wade in Australia were designed on this formula, it would appear that the departure from the exact truth as to the stresses claimed to be in them, will be quite marked. Many other curved dams have been built with long radii, and if they were stressed in proportion to the results to be obtained by the sole use of this formula, some of them would appear to be quite heavily stressed.

However, the ring formula does not apply, except as to the case of ascertaining a part of the stresses to be met in a single-arched dam, but what the stresses really are and how far this formula applies, is a different and longer story, not to be taken up in this article.

What is true and of importance here is that the use of curvature in a gravity section dam of great length is rarely ever considered in any other light than the general idea that the curvature will add to its safety. There are many curved dams now built that would be better dams if they had been built as straight crest gravity dams of equal quantity.

The New Big Bear Valley Dam Withstanding Heavy Flood of 1916

It is only well within the span limits assumed in the typical case above mentioned that the single-arched dam commences to show an advantage in quantities and equal safety over a straight crested gravity dam.

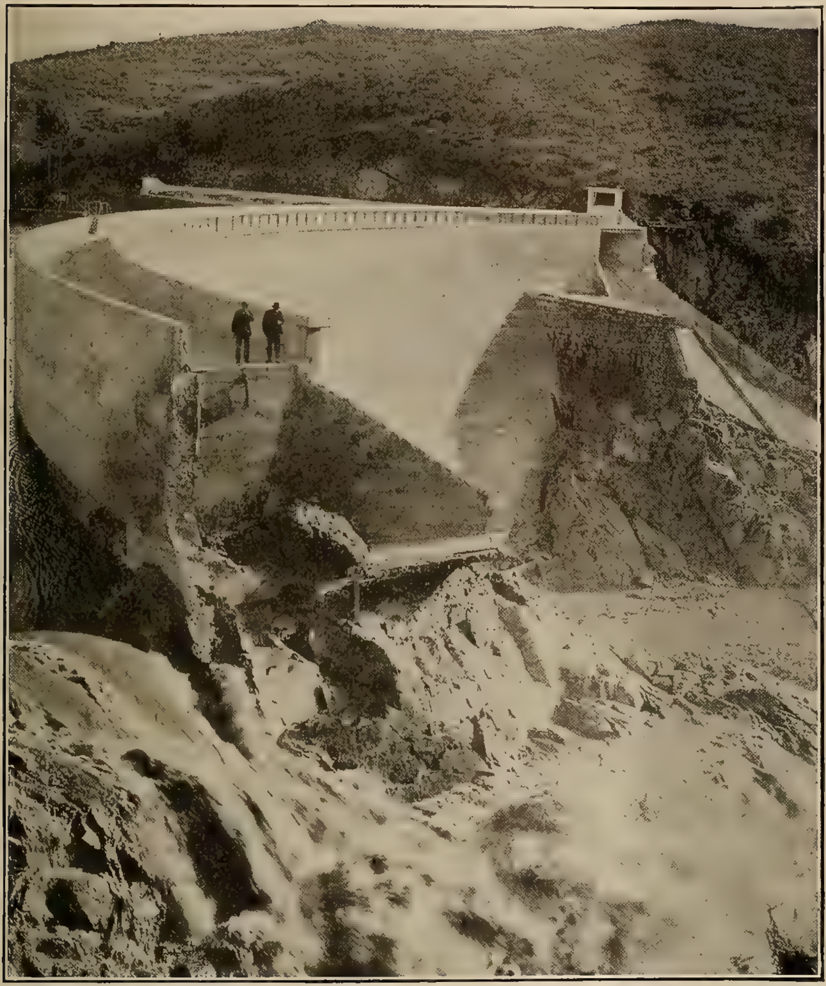
The constant angle of arc for minimum quantity, is difficult to apply in practice except in the case of an ideal site, and for such a modified multiple-arched dam will always be stronger and cheaper.

The bending reactions at the abutments of the thick sections of single-arched dams have not been given due consideration, for if the abutments are of material fit for abutments, these will be very large; and if of soft and yielding material, as is sometimes

the case, they are not abutments at all and the dam does not act as an arch.

Rock that is shattered and that can be washed out by water will not constitute an abutment to take a horizontal loading.

The single-arched dam is not readily adapted for use as an overflow dam, for if it is thin enough to warrant its use over a gravity section dam, it will have almost vertical back slopes.



The Well-Known Sweetwater Dam With Abutments Being Destroyed in Heavy Flood of 1916

(An Example of the Difficulty of Getting Abutments at the Sides of a Canyon Sufficiently Firm to Resist Arch Action)

The comparative thinness of section of a single-arched dam of large span is its only chance for economy over a straight gravity dam and this thinness of section is its most dangerous feature.

In order to demonstrate this statement, we must consider the limitations of the materials we can use for dam construction. Portland cement concrete has become considered as almost a synonym for masonry, when discussing dams.

Concrete is subject to two causes of change in volume that are both in the same direction; swelling with increase of heat and moisture content and shrinking with the loss of these.

In practice, dams are built in the summer when it is warm and the concrete will not freeze. The concrete in setting generates an additional amount of heat, sometimes reaching 150° F. for large masses, such as are here considered; also, it is placed wet and will retain at least a normal saturation. The temperature will drop permanently to the mean normal for the location, the moisture content will also decrease to a degree, permanently at the top of the dam. The volume change is in proportion to the unit length of the wall and will be through a greater range in a thin wall than in a thick one.

A single-arched dam, having the economic arc of 133° 34′, will be 1.27 times as long as a gravity dam for the same site, and the stresses set up by the volume change are so much greater due to this length; and they are also more by reason of the fact that the gravity dam will be much thicker and subject to a smaller range of change.

The range of change will be directly proportional to the stone element in the material of the dam as this is not subject to any moisture change and only a slight temperature change.

If the single-arched dam is used as a diversion dam and is always wet it will not be subjected to great changes of moisture content and the temperature drop is likely to be offset by the excess due to complete saturation, so that such dams will not crack to any dangerous extent. It is where the service is for water storage that the worst conditions prevail, where they are now full and then empty.

In locations where the range of temperature is large and for a service where the reservoir is held empty for a good part of the time, the single-arched dam will be subjected to the greatest stresses.

The fact that the base of a single-arched dam is attached to the foundations may be an apparent advantage but in practice is its worst feature, for, while it would assist in the stability of the structure were it possible for it to act as a whole, it merely prevents arch action of the separated voussoirs and introduces as the only stress the cantilever action tending to overturn them.

The economy in material of the single-arched dam will limit it to short spans, and if it is to show a great saving over a gravity dam it must do so by its reduction in thickness as it is longer, this again accentuating the dangers of cracking.

In any case of a large or even moderate span, it is impossible to reinforce the walls of the single-arched dam sufficiently to prevent cracks. The only alternative is to provide artificial joints that can open up to prevent natural cracks that might occur diagonally across the wall, permitting a voussoir to fall out down stream.

As these artificial joints must be placed fairly close together to prevent intermediate ones forming, the unstable separate voussoirs will be in danger of breaking off at the bottom.

As an example in illustration of this point, the

Lake Spaulding dam was provided with artificial joints at each 80 feet of crest length, but the stresses set up by the agencies above mentioned, caused other natural cracks between each of these joints.

All of the Australian single-arched dams have cracked vertically and some of them along the step lines where stepped on the downstream side, as reported to the writer by the contractor who built them.

The Salmon Creek dam has cracked at the crown and has a permanent open natural crack from top to bottom through which quite a large stream of water flows, according to a recent visitor to this structure.

The combined permanent shrinkage will open up cracks in artificial joints or make natural ones if joints are not provided, and with joints forming open cracks, with the base rigidly fastened to the foundations, there can be no arch action whatever. When the reservoir is full, there will be cantilever action and such only, unless the blocks of which it must consist are sheared off or are broken by tension and take arch action by sliding into a new position where they can so act.

If all should move at once, all would be well, but in practice all are not similarly fastened to the foundations. If the section is thin enough to be economical, it will be too thin for a cantilever and must be ruptured.

There is less danger of cracking and less danger from these in a gravity dam with straight crest for the walls are thicker, which will reduce the range of change and are shorter which will reduce the units of length. There is less danger for the gravity dam if cut into thin slices, as each slice would be equally stable. The volume change is directly in proportion to the unit length, and also will vary inversely with the thickness, so the cracks will be smaller, and if made by artificial joints, are harmless as well.

It will then appear that experience has shown that the straight gravity dam will be both safer and cheaper for wide openings, that the single-arched dam should be confined to very narrow and deep openings where the abutments are sound, which would lead to the conclusion that its field of usefulness was exceedingly limited.

Such very narrow and very deep openings are most economically closed by means of a single-arched dam having a minimum radius of intrados or a constant angle of intrados of 180°, as suggested for the Shoshone site.

Even so, there is no opening that cannot be more efficiently closed by a modified multiple-arched dam.

The conclusion of the whole matter is that to be efficient, by which is meant to be free from technical objections and economical as well, the arch when used, must be used as such, and as free from all of the limitations as possible.

The arch, to be efficient, must take its loading as an arch, and to be an arch, must approach as nearly as possible the ideal conditions for the arch action determined by the ring formula. It must be as thin as is practicable, it must have as short a radius and span as possible, it must not be confined and subjected to base shear or contilever action, must be provided with a uniform span so that it may be hinged where it is required to be thick to take its load, and must be thin enough to be protected readily from the small volume change stresses due to small dimensions, by steel reinforcement, and the only way that all of these conditions can be met is to place the arches on closely spaced artificial abutments, in other words the dam must be multiple-arched.

The multiple-arched dam, consisting of a number of relatively thin and small cylindrical arches, supported by artificial abutments, spaced a uniform distance apart, suggests itself as the logical and scientific solution of the problem of the proper use of the arch for a dam.

In this type of structure, all of the features that are objectionable in the single-arched dam and which are the result of its size and shape, are eliminated by the changes in size and shapes of units introduced in the multiple-arched type.

The span can be made of any desired width to be the most economical for the site. The angle of arc and radius can be made the most efficient. The sloping of the arches down stream in order to utilize the water load to assist in giving it stability removes the danger of base shear, as the thrust is toward the foundations. The great length of arch barrel compared to span, removes all cantilever action. Its comparative thinness makes it the nearest approach possible to a pure arch tangentially stressed in conformity with the ring formula, and for resisting water pressure there is no better shape possible.

The arch walls are thin and therefore there is no heat generated by the setting above that of the air at the time of setting. Being thin it has but a small temperature drop from the time of setting to the time of service. Being thin, the arch ring is readily reinforced for the small changes that can take place. The opening to be closed has parallel sides so the arch can be hinged where desired and necessary. The stresses can be maintained almost uniform throughout the arch.

Of all the stresses set up in both the straight and curved types of solid masonry dams, there is none of them so ill defined and uncertain in amount and resulting influence for causing failure as that of the upthrust of the water confined under or in them, resulting from porous foundations or days work joints, for this may run all the way from full to only a small amount.

It is this upthrust acting in conjunction with the regular water load, both tending to slide and overturn the dam, that has been the cause of the failure of most all of the solid dams that have failed.

In the multiple-arched dam, upthrust is cut out of the problem, for there can be none, the water being free to escape between the relatively thin walls of the arch toe and the buttresses.

It cannot overturn, for the structure is provided with balanced stability, the base load being evenly distributed.

It cannot slide on its foundations for it has a base shear strength having a safety factor of 15, besides having the friction resistance of the load.

All of the loading is downward on the foundations and this loading is light.

All of the stresses are determinable to a marked degree of accuracy, so that they can be provided for in the design.

All of the stresses are in compression, the best service for concrete, and this is given a safety factor of 10.

All stresses are kept nearly equal and it is there-therefore the scientific design.

The Multiple-Arched Dam Under Construction

With all of the advantages of the solid types and none of their disadvantages, with their most dangerous elements eliminated, with a strength five times as great, with equal permanency and watertightness, and all this at a cost of half that of the other types, the multiple-arched dam points out in its results the true path to follow in order to reach the goal of perfection in design.

THE DOWNSTREAM FACE OF THE SAN LEANDRO DAM

This picture, taken recently, shows the downstream face of the San Leandro Dam of the Peoples Water Company, near Oakland, California. This dam, constituting as it does a remarkable achievement in dam construction, due to its being one of the first high

The Downstream Face of the San Leandro Dam

dirt dams successfully constructed in the West, presents at the present time an unusually satisfactory showing on its downstream side in solidity and firmness of structure. In the picture the drains and general surface condition are shown which clearly indicate this favorable feature in design of dams of this type.

OZONE FOR THE CHILDREN—III. OR ENGINEERING TWISTERS RETOLD

A quiet little fellow, evidently an automobile enthusiast, but hitherto unnoticed, now injected himself into the conversation by describing a problem he had encountered in following up tire troubles in operating his automobile for the agricultural power sales department of a prominent hydroelectric company. Thus he proceeded:

My auto is twice as old as my tires were when my auto was as old as my tires are. When my tires become as old as the auto is now, their sum will be 9 years. What is the age of my auto and of my tires?

Let $x =$ auto's age.

Let $a =$ difference between auto and tires.

Then $x - a =$ tires age.

Auto was $(x - a)$ when tires were $(x - a - a)$

$\therefore x = 2\,(x - 2a)$.

$x = 4a$.

Auto will be $x + a$ when tires are $(x - a + a)$.

$\therefore 2\,x + a = 9$.

$2\,(4a) + a = 9$.

$a = 1$.

$x = 4$ yrs. (auto.)

$x - a = 3$ yrs. (tires.)

THIRTY THOUSAND FIRES FROM CARELESS USE OF ELECTRIC APPLIANCES

A new form of fire peril is coming into prominence as a cause of much destruction, and its fires are so directly associated with carelessness that it has been deemed necessary to issue a special warning to the people of the United States. Because of their convenience, small electric devices, such as pressing irons, curling irons, toasters, electric pads or blankets, electric plate warmers, and electric sterilizers or heaters are now to be found in almost every community. If these were used with proper care the danger would be negligible, but, unfortunately, a proportion of their users does not realize the peril of leaving them in circuit when not in use. In such cases these devices tend to become overheated, whereupon they are likely to set fire to anything combustible with which they are in contact.

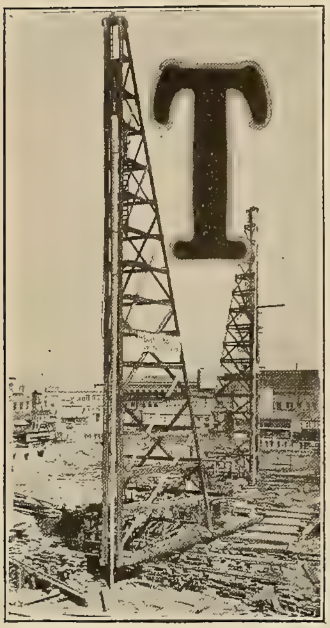
Fires of this class furnish a special peril to life, being most frequent in dwellings and often breaking out at night. A characteristic example is that in which an electric pressing iron is left upon the ironing board, with the current turned on, and then forgotten. In such a case the fire may not occur until some hours later. The burning of the residence of John Wanamaker, several years ago, was due to an electric pressing iron.

That this form of hazard is already assuming large proportions appears from the statistics. For example, Actuarial Bureau of the National Board of Fire Underwriters in one day noted approximately one hundred reports of fires from this cause, out of a total of two thousand losses in the day's reports, and it estimates that small electrical devices are causing fires at the rate of 30,000 or more in the course of a year.

A NEW RECORD FOR FOUNDATION PILING

BY JOS. M. McCOY

(Fifty miles of piling is an astonishing figure to mention in connection with the creation of foundation footing for an office building, and yet this is the combined length of piles recently driven for the great Southern Pacific building now being erected at the foot of Market street, in San Francisco. Many unusual engineering feats encountered and overcome in the work are described in this article, the author of which was superintendent for the construction company which performed the task.—The Editor.)



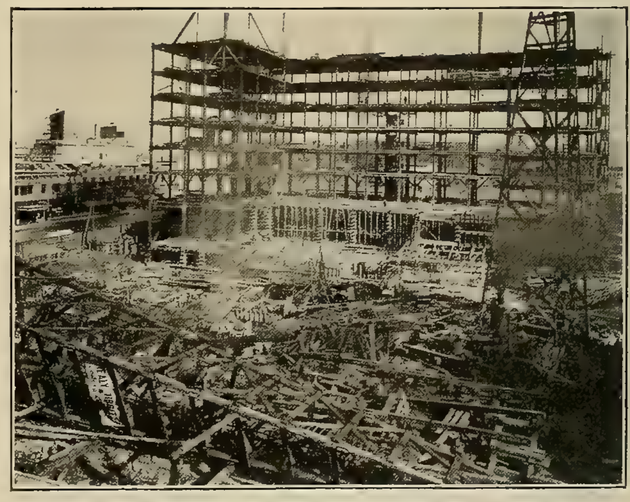
A Giant Pile Driver for Piles 130 ft. in Length

THE work, just now completed, of creating a foundation for the new Southern Pacific General Office Building on lower Market Street in San Francisco has attracted considerable attention locally and a brief description of the job will undoubtedly prove of interest. The subground required to furnish foundation to the finished building, a modern steel frame structure of ten and fourteen stories and approximately 275 ft. by 210 ft. in plan, consisted of a surface crust of various filling overlying the original bay bottom strata of mud and other soft sedimentary deposits with harder bottom at an uncertain depth which presented unusual features as the driving of the piles progressed. As a preliminary test of foundation conditions, four timber sounding piles 130 ft. in length were driven to actual refusal with their points on hard material at approximately 130 ft. below the street curb; the level of the hard stratum being verified by the sinking of a well hole. Two of these test piles were loaded with pig iron equal in weight to at least twice the ultimate foundation load to be carried by any pile, making a satisfactory test. Accordingly pile clusters were chosen as the support for the steel column footings of the building, the piles to be of the best Douglas fir obtainable and not less than 115 feet in length, the average cut off for piles according to the foundation plans being 15 ft. below the street curb and thus several feet below the permanent water table for this locality.

As a preliminary to pile driving, the basement section was excavated by a steam shovel loading into motor trucks with back-dump bodies. The excavator was an 18-ton revolving shovel with ¾ cu. yd. dipper, and eight or more 5 yard trucks gave excellent satisfaction. Some water and many obstacles were encountered, but the steam shovel, aided by compressed air drills and more than 1200 pounds of 40 per cent dynamite exploded within a few feet of the city's busiest thoroughfare, was equal to every task imposed. In addition to loading out approximately 20,000 cu. yds. of debris fill, sand and blue mud and clay, the shovel with jack hammers and explosive crumbled 2000 cu. yds. of reinforced concrete and masonry foundations. Hundreds of old piles were encountered, necessitating sawing, chopping or pulling with the shovel; timber structures with teredo eaten piles indicating old wharves, were uncovered and removed; and much large timber and "scow" building foundations, consisting of many ply of interlaced redwood, were dug out. All timber encountered below minus ten feet from curb was in an excellent state of preservation. Several pumping units kept down the water during the digging, and by the generous use of heavy planking the steam shovel and motor trucks were held up in the soft material.

But the greatest interest in this as a foundation job probably centers in the handling and driving of the piling, due to the great size and length of the piles and the strength and height of the machines necessary to drive them. The somewhat over 2100 long piles under the main building were obtained from the Douglas fir forests of Oregon and transported overland by Southern Pacific railway lines (about 15 piles being loaded on each three flat cars) to the Oakland Estuary. Towed across the bay in rafts, the piles were hoisted from the water on the San Francisco side by a floating derrick and hauled to the site of the work butt end on trucks pulled by six horse teams. A teamster piloting his 200 ft. long "caravan" through city streets had troubles of his own.

The average pile had a butt diameter of 20 inches, tip diameter of 10 inches, and weighed 5 tons. Some



The Foundation Setting for the Largest Steel Structure West of Chicago

of the larger sticks ran butt 30 inches, tip 16 inches, and weight 7 tons. A considerable number of piles over 130 ft. in length were handled and driven, the longest pile being 137 ft. There is one long pile for approximately every 22 sq. ft. of foundation area under the main building, giving a pile occupied area of about 10 per cent and a pile occupied volume of from 7 per

cent to 8 per cent. The pile volume would be equivalent to a ground raise of 9 ft. over the area piled. Of course not all the displacement of the piles was felt in the raise of the ground during driving, the compacting of the sub-ground and the driving out of water taking care of a considerable amount. To express again, however, the quantity of timber (in piling) put into the foundation, it would approximate 16,000 cu. yds. or 5,400,000 ft. board measure. Or again, the piles placed end to end would reach 50 miles.

The two main pile drivers used were built especially for the job; the sills being 60 ft. long, height 135 ft., and strength and weight in accord with the heavy work to be performed. The heavier machine of the two weighed 85 tons, contained 30,000 ft. board measure of pine and Australian iron bark timber, and 5 tons of bolts and hardware, and was equipped with a steam hammer weighing 16,000 pounds. The towers for both pile-drivers were framed and assembled complete on the ground and then raised to the vertical position by the donkey engine on the stern of the driver operating through heavy rigging. Both towers were raised and lowered without a mishap; the amount of the forces operating, however can be gained from the fact that the weight of a tower (with temporary bracing, and rigged for raising) was 45 tons and the height 135 ft.

Pile driving records would indicate that the solidity and permanence of the pile foundation secured for the building is unquestionable and that all piles will bear safely far more weight than any foundation load to be imposed.

G. B. Herington, engineer in charge for Assistant Chief Engineer J. Q. Barlow, has been in charge of the work for the Southern Pacific Company. The contractors performing the excavating and pile driving work were Healy-Tibbitts Contruction Company of San Francisco.

PRESERVATION OF POLES

One of the most important factors in determining the value of a pole is its ability to resist decay in contact with the soil. While durable woods are generally preferred as pole timbers, there is a tendency toward purchasing other species which are not as durable, but which can be rendered less liable to decay by preservative treatment.

In the treatment of poles several methods are used. Among these are the brush treatment, the open-tank treatment, in which the poles are stood on end in open tanks or vats containing the preservatives; and the pressure treatment, in which the poles are placed in cylinders into which the preservative is then run and pressure applied to force it into the poles. Much progress is being made in the butt treatment of cedar poles by the open-tank method, which is being used extensively in Idaho, Washington, and California, and in the Minneapolis and Chicago districts. A considerable proportion of the cedar poles sold receive a butt treatment.

THE BEGINNINGS OF THE NEW SAN PABLO DAM

The San Pablo dam, construction upon which was initiated about six months ago, is located in the San Pablo Valley about five miles north of Berkeley, and five miles east of the city of Richmond.

Since the matter of the building of this dam is now a very live topic before the California Railroad Commission, its general proportions will be of unusual interest to our readers. The work is being carried through by the East Bay Water Company which supplies water to the cities on the eastern side of San Francisco Bay.

The Location of the San Pablo Dam

This project involves the construction of an earth dam 165 ft. in height, having a crest length of approximately 1375 ft., a waste tunnel 14½ ft. inside diameter and 1,350 ft. long, an outlet tunnel 7 ft. by 9 ft. in cross section and approximately 15,000 ft. long, together with a modern filter plant and all necessary appurtenances in connection therewith. The reservoir when complete will have a capacity of approximately 1,900,000,000 cu. ft. The project will require a period of approximately three years for its completion.


Foundation Piling Across San Pablo Gorge

William Mulholland is the consulting engineer, G. H. Wilhelm is the acting manager of the company, and A. Kempkey is the engineer in charge of the project.

The dam foundation has been cleared and bedrock exposed, as shown in the illustration. The piling that appears in the central view has been driven across the narrow aperture of the canyon in order to make an impervious medium to prevent future seepage through the foundation stratum.

SHORT JOURNEYS IN PACIFIC LANDS

(A discussion of the traits and customs of our Latin American neighbors with especial view toward creating closer engineering and commercial relations with them, is especially opportune at this time. Here is an article by an American engineer who recently spent two years on the West Coast of South America during which time he was actively engaged as operating engineer of a prominent hydroelectric system in Peru. The author is now with the engineering force of the Pacific Tank & Pipe Company in San Francisco.—The Editor.)

ENGINEERING OBSERVATIONS ON THE WEST COAST OF SOUTH AMERICA

BY RALPH W. REYNOLDS

An Ancient Peruvian Engineering Accomplishment—a Stone Neck-breaker. After Passing the Head of the Victim Through the Opening, the Body was Thrown up Over and the Neck Thus Broken

MUCH has been written and said in the past two years on the matter of our foreign trade and particularly with reference to our relations with Latin America. This is a subject of vital interest to our young engineers, for it is through this work of developing our trade that they are finding new fields of endeavor—particularly those who have a liking for pioneer work.

The engineers' relation to this work is a matter which should be of extreme interest to commercial men, for in the last analysis, the engineer is the scout for our army of commercial invasion, and as a "trade-getter" must be reckoned with.

The past two years have seen great improvements in our methods employed to capture this trade, and in our methods of handling it after it is ours. This has come through careful study of conditions and the resulting increased understanding of our neighbors, and their wants and needs.

However, our handicap does not consist solely of this lack of knowledge and experience—our heaviest handicap lies in characteristics which are peculiarly Anglo-Saxon.

In the American this is expressed by a marked contempt for, and a suspicion of, anything not American. This, in the writer's opinion, is one of the greatest obstacles we have to overcome in our effort to take our rightful place in Latin American relations.

The Latins are as distrustful of us as we are of them—a situation brought about through lack of understanding—or perhaps through lack of effort to understand. The fault lies with ourselves, for we seem to forget that we are foreigners and that the obligation lies with us. There are Americans in South America who seem to hold to the belief that English should be spoken everywhere for our convenience.

German success in the foreign field is largely due to the attitude of the German toward the land of his adoption, for unlike the American, he becomes truly a part of the country in which he is earning his livelihood. He soon speaks Spanish fluently, so eventually, he usually marries a South American, and as nearly as possible adopts the customs of the country. It is seldom that a German returns to his native land.

On the other hand the American is inclined to look upon foreign service as a transient condition. He is usually a poor linguist—largely because of a lack of interest in his new surroundings. To develop to the fullest extent his potentialities to benefit his country, the engineer in foreign service should aim to school his mind so as to become as much as possible a part of the country.

South America offers a life of keen interest to the engineer. There, as in no other part of the world, can he satisfy his craving to create. Most of his work is connected with large enterprises. Probably nowhere else is such great potential wealth coupled with such lack of development as is evidenced in the Andes. It is said that the Andes contain every known mineral—and the statement is probably true. There are many other resources—notably agricultural, which will lead eventually to great developments in irrigation and drainage.

The Andes are also rich in water power—a fact very soon impressed upon the traveller. Splendid power sites are available at altitudes as high as 14,000 feet. Streams at this elevation combine precipitous descent with steadiness of flow which is most unusual. This is due to the fact that the water is stored in glaciers, to be drawn upon during the dry season. Small reservoir sites abound, and these can be cheaply developed and used as regulators for this glacial supply. At present, of course, these sites are valueless except as they may be utilized in connection with mining.

Repairing a Penstock Break in the High Andes

One of the greatest needs is a comprehensive system of railroads. Railway construction is extremely difficult and expensive and taxes the ingenuity of the engineer to the utmost. Little can be expected along this line, except in connection with mining, for this is the only traffic able to bear the burden of the heavy capitalization involved. Here is a large future field for hydroelectric activity. Fuel in the higher altitudes, notably in Bolivia, is very expensive, and electrification of these railways would

prove an economy even with a comparatively low traffic density.

At present the crying need of all West Coast countries is capital. This, of course, for some time to come will only be attracted through the opportunities to be found in the mining field. So, in the last analysis, the development of all other resources will be dependent upon the mineral wealth of these mountains. The completion of many of the projected mining railroads will open vast areas of rich agricultural land on the Eastern slopes of the Andean ridge.

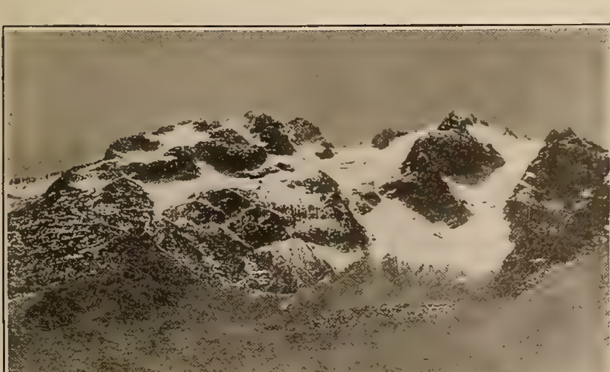
Capital, in the past, has been very timid about entering these lands of opportunity because of their political instability. This condition, happily, is rapidly becoming a matter of history. The day of the opera bouffe revolution is passed and the governments of these republics are coming more and more to realize their economic needs. With this realization is coming a more encouraging attitude toward foreign capital and at the present time, this means American capital.

This in turn means greater opportunities for American engineers. A word of warning here, will probably not be amiss, although it has been given by many writers before. This is in reference to the danger of going to South America on "spec." One should have a contract, or at least a promise of something definite before venturing into the foreign field. Unemployed foreigners are usually regarded with suspicion and the positions offered are not likely to prove very attractive.

Among the more promising fields may be mentioned sales engineering. The large trading companies such as W. R. Grace & Co., employ many engineers in this capacity.

The foregoing is not intended to give the impression that success is to be attained with less effort abroad than at home. Opportunity certainly is more generous with her gifts—but character still remains the deciding factor. A young man is likely to be given responsibilities beyond his years and often the test in resourcefulness is very severe. Tact is always required to fill executive positions and this is particularly true in handling peon labor.

It must be borne in mind that every man is not fitted for foreign service—tact, resourcefulness and integrity are essential—as are also, a genuine love for the life and an understanding and liking for the people. Temptations are often great and many a life has been broken through homesickness. This is probably the greatest trial of all. The writer is careful about recommending foreign service unless he is sure of his man.



Perpetual Glaciers for Constant Stream Supply in Hydroelectric Development—Elevation 20,000 ft. on Divide Between Amazon and Pacific Drainage in Peru

Llama, the Burden-Bearers of the Andes, in Front of an Ancient Piece of Inca Masonry

To some, the life is fascinating and full of interest. The South American will usually be found to be extremely hospitable and courteous, in both social and business relations. The life need never be dull; for though one may suffer greatly from nostalgia, it will be found that the foreign colony offers many diversions for the new comer.

CHINESE WOOD-OIL INDUSTRY

One of the most important of Chinese products—and one for which Hankow acts as the chief exporting center—is t'ung-yu or wood oil. This oil is obtained from two varieties of Aleurites, a small genus of the spurge family. Each variety has rather sharply defined boundaries, the mu-yu shu or wood-oil tree being found for the most part in the southern Provinces, while the t'ung-yu shu, literally tung-oil tree, is confined largely to central and western China. By chemical analysis the oils of these two trees are found to be practically the same, but the t'ung-yu shu is of far more importance because of its greater hardihood and wider distribution. Fully nine-tenths of the so-called wood oil exported from China is made from this variety.

T'ung-yu is used as an adulterant in the manufacture of lacquer varnish, as an illuminant, and as an ingredient in concrete, and when mixed with lime and bamboo shavings it is used by the natives in calking their boats.

USE OF BOILERS IN ARGENTINA

British-made boilers are so generally used throughout Argentina that they are regarded as the standard, and contractors, constructors, and engineers who are practically all either Argentinians or Europeans, are more accustomed to work with British boilers in their plans, construction work, and operations. The British boiler is somewhat of a different design and type to the American, the American boiler being lighter. The horsepower of the American boiler runs slightly over the rating as used in Argentina, based on the metric system of measuring heating surfaces. The metric system of measurement is legalized in Argentina and almost exclusively used.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(Trade acceptances are entering more and more into the business activity of the contractor and dealer. Here is a timely discussion of the salient features of this form of credit so vital to future success in business enterprises home and abroad. Other subjects of current interest to the contractor and dealer are also discussed in this issue on dry cells, troubles with brushes and methods of connecting plug cut outs. The author is power apparatus specialist for a well known supply house in San Francisco.—The Editor.)

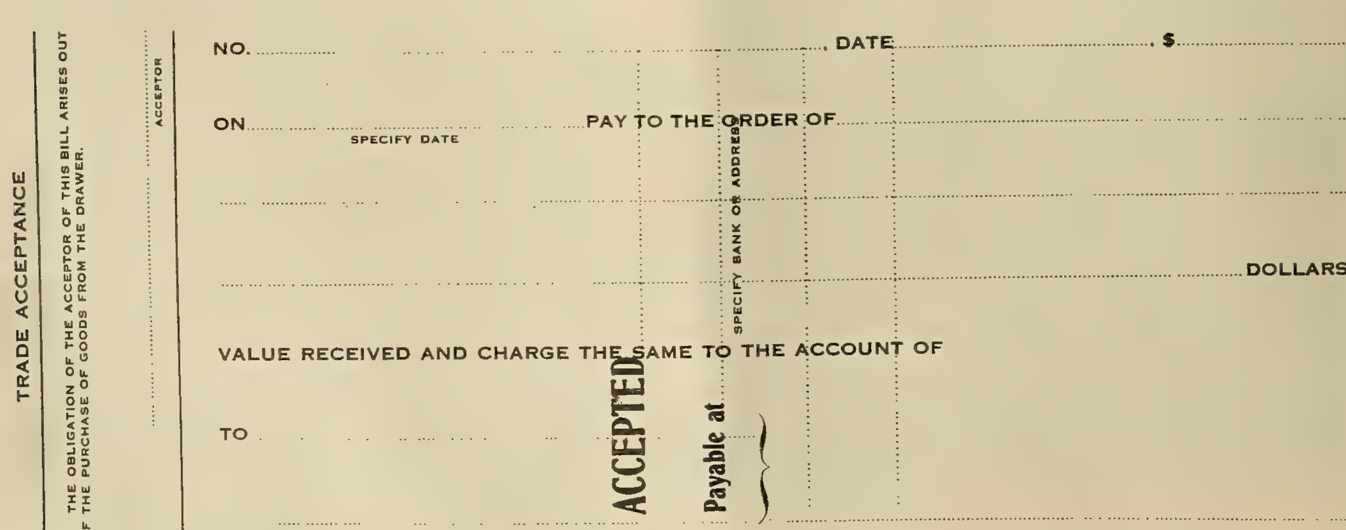
TRADE ACCEPTANCES

The subject of "Trade Acceptances" has been given and is continuing to receive considerable thought and study on the part of the electrical business man on the Pacific Coast. The plan appears to be in operation only in a limited way at the present time. It has been demonstrated in the brief experience that it cannot be used on any particular class of trade as a whole. It seemed to be the idea, up to a short time ago, to use it most entirely with the Contractor-Dealer customer. If that plan had been persisted in it would mean that a good part of the paper would have to be taken on liberal time allowances. There could be no serious objection to allowing some extra time by taking acceptances at longer than ninety days, provided interest at legal rates is paid, for it might be better for the supplier to have some few extended accounts in the shape of acceptances than to worry along with an open account. The customer who might be allowed such extra assistance would undoubtedly appreciate that his continued line of credit depended upon the faithful performance of meeting the acceptances without question at due dates.

The Contractor-Dealer is in about the same situation as the Supplier, in that he cannot hope to obtain acceptances from a majority of his customers. He will also be able to use the plan only in individual cases. Contracts almost invariably call for payments at stated periods in cash, or when certain work has been completed. It does not happen very frequently that the owner pleads for more time. If the owner needs more time he generally obtains it by putting in claims on the job. This is not in the main the reason for slowness in paying on the part of the Contractor-Dealer. The question of how soon the contractor can get his money in view of the stated time for payment in contracts depends in the long run on his ability as a collector. If he does not need to look out for his lien rights, acceptances should be secured when extra time is required, provided the customer is good for the amount, and there is a thorough understanding that no extension can be allowed.

The larger companies appear to be trying to work into the plan gradually with individuals, rather than groups of any particular classes of trade. It is quite generally understood that it will take time to secure the use of Trade Acceptances, universally, as in some of the European countries. The Book Account has been so long established that it will take some time to educate the public into making such a decided change in the manner of making settlements. The present plan is wrong, in that the merchant acts as banker for his customer when accounts are not paid on terms. Credit becomes Capital when bills are not paid at due dates. It appears to be possible to obtain relief from this burden in a limited way by the judicious use of the Trade Acceptance.

It will be necessary to make concessions in order to assist in getting the idea across, but the penalty should not be anything more than concessions of time. The banker must also assist by allowing a lower rate for discounting acceptances. In some cases a discount of 1 per cent is being allowed for thirty-day acceptances received on the 10th of the month covering the prior month's purchases. This works out to the extent that the customer obtains almost sixty days, for the account would average sixty days on the 15th of the month, five days after the due date of the accept-


TRADE ACCEPTANCE

THE OBLIGATION OF THE ACCEPTOR OF THIS BILL ARISES OUT OF THE PURCHASE OF GOODS FROM THE DRAWER.

ACCEPTOR

NO. .... DATE .... $ ....

ON .... PAY TO THE ORDER OF ....
SPECIFY DATE

.... DOLLARS

VALUE RECEIVED AND CHARGE THE SAME TO THE ACCOUNT OF

TO ....

ACCEPTED

Payable at

SPECIFY BANK OR ADDRESS

BD 66—1000-11-8-15

Form of Trade Acceptance Recommended by the Federal Reserve Commission

ance, and obtains in addition 1 per cent cash discount. This is altogether too high a penalty, for when the supplier also pays his bank for discounting the paper, the net cost of the additional capital is so expensive that it would be impossible to make anything on it, even if the business were run on a very efficient basis.

In addition, the seller is carrying a contingent liability at the bank, for if the maker does not pay at due date the seller must. This works out to the end that the seller is "holding the sack" for both the bank and the buyer and paying for the privilege. This is not very satisfactory from the viewpoint of the seller. The buyer who does not cash discount, will take on the average sixty days and longer. He is the one from whom acceptances should be obtained. The seller would undoubtedly cancel his lien rights by taking an acceptance. This is only a minor angle, but it must be considered in individual cases.

This problem is one which the merchant must work out for himself to a large extent. A lot has been heard on the subject from bankers. Their views, while not entirely selfish, are based to some extent at least on benefits that will come to them in the shape of more desirable discount paper, also increasing the means for bank discounts, and in other ways acting to their advantage. One banker who has been very strong for the plan, has stated that it should not be used with the "slow pay," who generally does not know definitely when his accounts will be paid, owing to the nature of the business methods used, which give his customers little worry about settling up. He also remarked that a trade acceptance as against an open account in no way increases the ability of the customer to pay more promptly. He also considered it a blow to the plan to adopt it with any other class of trade than those who pay reasonably promptly.

The problem, as stated, must be worked out by the business man and not by the banker. If he takes acceptances from his good customers who pay promptly, he would be little better off than now, and would have the "slow pays" to still worry him. The acceptance is not going to benefit the seller on that class of customer. There are other things that must be worked out with the "slow pay" before the acceptance will enable him to pay more promptly. It may help some but not a great deal.

The plan, in general, must not be jeopardized by going at it in a hap-hazard way and without giving serious thought that there must not be any failure to pay at due date. Present business ethics require that bank checks be paid according to dates. A check returned from the bank marked "returned account insufficient funds" is enough to cancel the credit standing of the maker. The failure to pay a "Trade Acceptance" at due date should be made equally important as having funds in the bank to meet checks in payment of supplies. One or two houses who have used the plan report that 10 per cent of acceptances received have not been paid at maturity. This means that the plan has not been tried out on the right customer, but undoubtedly more care will be used as a result of experience obtained.

The "Trade Acceptance" plan can in time be worked to good advantage by the supplier and possibly the Contractor-Dealer to a lesser extent, but it must be applied only to that part of the trade which can be of help in putting it into successful operation. Any mis-steps made now will surely have bad effects in getting the plan in future time, into general operation.

INCREASING LIFE OF DRY CELLS

A well known manufacturer of battery cabinets especially designed for use with dry cells states that the average service life of a bank of such cells can be increased approximately fourfold by using double the number of cells ordinarily required in any particular installation. This statement is confirmed by actual life tests.

To obtain these results, the cells should be arranged in two banks connected in parallel thus reducing the drain on each bank to one-half of what it would be if used alone. The economic advantage of using two or more groups in parallel is especially noticeable when the cells are to be used for severe service as they would be for ignition purposes in connection with large gasoline engines or for similar service.

This scheme can also be used to very good advantage in small telephone exchanges where the ringing current is supplied by dry cells operating through an interrupter or pole-changer because during certain hours of the day the maximum current demand upon the battery will be considerable above the average and further may be required so frequently during the hours of rush business that the cells do not have time to recuperate.

For light service such as operating small annunciators, signal systems, individual telephones and the like, a single group of cells is usually more economical than two or more groups because any saving that might at first thought seem possible is offset by the deterioration caused by local action on standing.

TROUBLE DUE TO INCORRECT BRUSHES

Much of the trouble experienced with commutators can be traced to the careless substitution of carbon brushes. In connection with this statement it should always be remembered that the function of a brush is not only to collect current from the commutator but that it actually assists in commutating the current in the armature coils. Therefore when a brush differing in characteristics is substituted in place of that particular grade originally furnished with the machine or recommended by the manufacturer troubles may develop, some of which can ultimately prove expensive. These remarks apply also in a measure to brushes for collector rings.

PROPER METHOD OF CONNECTING PLUG CUT-OUTS

Some wiremen do not seem to know that there is a right and a wrong way of connecting the common main line plug cut-out into the circuit. The correct way is to place the cut-out so the inner contacts will be connected to the line or live side of the system, thus leaving the outer shells dead when the fuse plugs are not in place. When connected in this manner there is less likelihood of shock or accidental shirt-circuits.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Chemi-hydrometry is daily solving more and more the problems of scientific and engineering measurement. In the issue of Feb. 15, 1917, results were set forth by operating engineers of the Pacific Gas & Electric Company wherein the electrical conductivity of boiler water and condensate was made use of due to its varying salinity, to ascertain the purity of water. Here is an excellent article wherein this author checks the accuracy and develops the theory for a method of flow measurement of water by injecting a salt solution of known weight. The author is professor of engineering mechanics at the University of California and a well-known authority on hydraulic research.—The Editor.)

A SMALL SCALE TEST OF FLOW BY CHEMI-HYDROMETRY

BY JOSEPH N. LE CONTE

A great many measurements of flow have lately been made using the method of chemi-hydrometry, or saline method. Many of these have been made on a very large scale, and with a great amount of care and refinement. Very few, however, have been checked against other methods of equal or superior refinement, because when carried on upon a large scale this becomes extremely difficult. The purpose of the following paper is to show that fair results may be obtained with ease on a small scale, even though great refinement is not attempted.

The measurement was made through a small centrifugal pump, for the reason that it furnished a convenient and easily regulated flow, and also because the mixing of the salt solution is so perfectly accomplished by the rotating impeller. The dosing solution was introduced into the suction elbow of the pump through a quarter-inch connection. The supply was drawn from a small tank mounted upon a platform scale whose beam was graduated to tenths of a pound. The connection between the tank and suction elbow was through a flexible rubber tube, and quick opening cock, whose handle operated between fixed steps. When this handle was so turned as to open the cock wide, the flow into the suction would be at a constant rate, provided the level of salt water in the tank was maintained at constant level. This condition was obtained by mounting a second similar tank and scale above the first, and keeping the level in the latter at a definite mark by hand regulation of the second. The total weight of dosing solution injected in a given time will then be the sum of the weights of the two tanks at the beginning, minus the sum of their weights at the end of the operation. One observer operates the quick opening cock, takes the time with a stop watch, and regulates the level of the salt water in the dosing tank. A second observer must take samples in clean bottles, of the dosing solution; of the original water, i.e., in the sump; and of the pump discharge while the dosing is going on.

The following is the theory in its simplest form. Let a saturated solution of salt of known concentration be injected into the suction at a known rate of q cubic feet per second. Let **b** be the weight of salt per cubic foot in **q**. Similarly let **Q** be the inflow through the main suction in cubic feet per second, and **B** be the weight of salt per cubic foot in **Q**. Finally, the outflow of the pump will be at the rate of **Q + q** cubic feet per second, and the weight of salt per cubic foot in it can be represented by **A**.

Then,

$$qb + QB = (Q + q)A$$

$$\therefore Q = q\frac{b - A}{A - B} \qquad (1)$$

and

$$Q + q = q\frac{b - B}{A - B} \qquad (2)$$

Let **x** be the volume of an analysis sample of **q**, **X** be the corresponding volume of a sample of **Q**, and **Y** of **(Q + q)**.

The quantities **b**, **B**, and **A** are determined from the samples best by the titration method, that is, by measuring the amount of silver nitrate necessary to precipitate the silver chloride in the solutions using bichromate of potash as an indicator. The amount of silver chloride necessary will vary directly with the weight of salt in the sample, that is to say, directly as the weight of salt per unit volume, and as the volume of the analysis sample. Hence if **r** represents the cubic centimeters of silver nitrate solution necessary to precipitate **x**, **R** that necessary to precipitate **X**, and **S** that for **Y**, then

$$r = Kxb; \quad R = KXB, \text{ and } S = KYA, \text{ and}$$

$$Q = q\frac{\dfrac{r}{Kx} - \dfrac{S}{KY}}{\dfrac{S}{KY} - \dfrac{R}{KX}} = q\frac{r - S\dfrac{X}{Y}}{S\dfrac{x}{Y} - R\dfrac{x}{X}} \qquad (3)$$

$$Q + q = q\frac{r - R\dfrac{x}{X}}{S\dfrac{x}{Y} - R\dfrac{x}{X}} \qquad (4)$$

This latter is generally the amount required.

Take the case of the small centrifugal pump already mentioned, where the salt solution was weighed out, and the true discharge (**Q + q**) measured volumetrically in a large calibrated tank in order to check the accuracy of the method.

Gross weight of two tanks........	57.10 lbs.
Tare	26.30 "
Pounds of salt solution used..	30.80 lbs.

Time, 4 minutes = 240 seconds.

Pounds of salt solution per second = 0.1283.

To convert this into cubic feet per second, we need the specific gravity of the dosing solution. This may

be obtained by an accurate hydrometer, or by chemical analysis using saline tables as follows:

Amount of sample used $= x = 2$ c.c.

Atomic weight of Cl $= 35.45$

" " Na $= 23.00$

" " NaCl $= 58.45$

Standard solution of nitrate of silver used contained 0.09951 grams per liter, and the amount of this necessary to precipitate the salt in the sample was 86.6 c.c.

$$\text{Weight of salt in 2 c.c.} = 86.6 \times 58.45 \times \frac{.09951}{1000}$$

$$= .5036 \text{ gram.}$$

Weight of salt in 1 c.c. = 0.2518 gr. (at 55° F.)
Hence from tables; Specific gravity is 1.163[1], and

$$q = \text{vol. per sec.} = \frac{0.1283}{62.4 \times 1.163} = 0.001767$$

cubic feet per second continuous flow of dosing solution into the suction.

Now in the analysis:

$x = 2$ c.c.	$X = 200$ c.c.	$Y = 200$ c.c.
$r = 86.6$ c.c	$R = 1.67$ c.c.	$S = 15.27$ c.c.

$$Q + q = 0.001767 \; \frac{(86.6 - 1.67)\ 1/100}{(15.27 - 1.67)\ 1/100} = 1.125 \text{ sec. ft.}$$

This same quantity was measured by volumetric displacement in a concrete tank, which had previously been calibrated by actual weight This measurement was made while the dosing was going on.

Hook gauge at start..............	4.25
" " " finish............	122.35
Rise in surface..............	118.10

Tank constant =1.523.

Total cubic feet of flow into tank $= 118.10 \times 1.523$ or 180.0 cubic feet.

Time 2 minutes, 41 sec., or 261 sec. The actual rate of flow therefore was 1.118 sec. feet.

[1] Chemi-Hydrometry—Benj. F. Groat. Proc. A. S. C. E. Vol. XLI. No. 9 p 2111. Also Kent's Engineers' Handbook.

THE ECONOMICS OF PUMP IRRIGATION

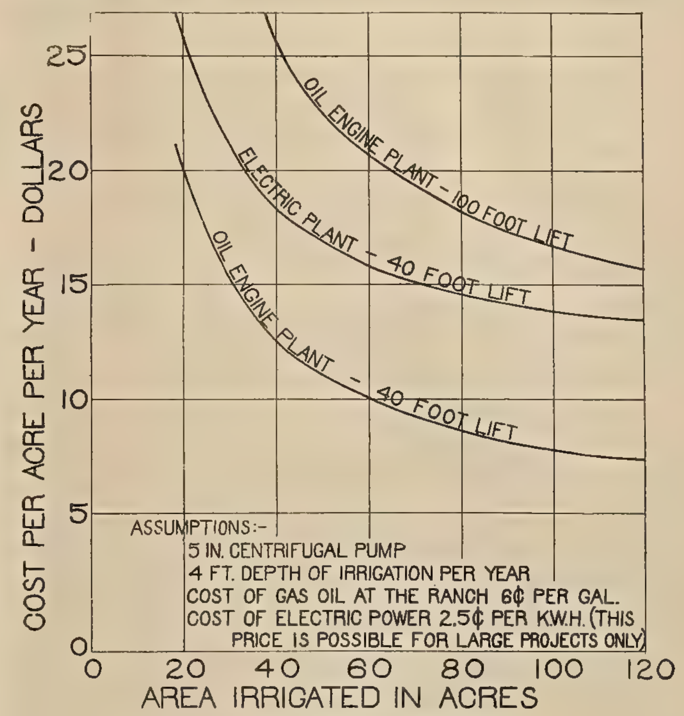
A study of the economics of pump irrigation has been made by the agricultural experiment station at Tucson, Arizona. The influence of acreage upon the cost of pumping is forcefully shown in the diagram given herewith which is taken from the twenty-sixth annual report of the station and which has just made its appearance. From this chart it is seen that pumping plants should be used continuously through the irrigating season and that a five inch centrifugal pump should supply water for at least 80 acres.

An Irrigation Laboratory Well

The University of Arizona has dug a pit to water level and installed a 16-inch stave pipe casing 200 ft. deeper in order to get experimental data on electrical pumping for irrigation. Tests are to be made on vertical pumps and much important data is expected leading to further economic uses of the electric pump.

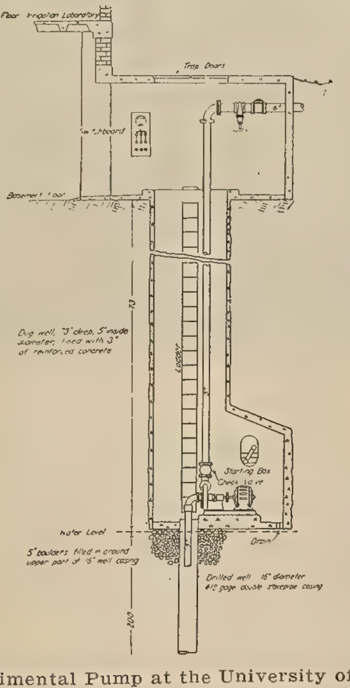
Pitless Pumps

Pitless vertical pumps with large bowls were first introduced in Arizona and California in 1909. They have come into use very rapidly and at the present



Cost Data on Pump Operation

time fully 50 per cent of the water pumped for irrigation in southern Arizona passes through pitless pumps. For several years the pumps of this type were brought into Arizona from Texas and in efficiency they did not measure up to that of the better class of pit pumps with which they came in compe-



An Experimental Pump at the University of Arizona

tition. Since 1912 the pitless pumps have been manufactured in California, and while the first ones showed no improvement, the California pumps made during the past year have been built on scientific designs, are of excellent efficiency, and comparatively free from mechanical troubles.

ELECTRIC COOKING AND HEATING

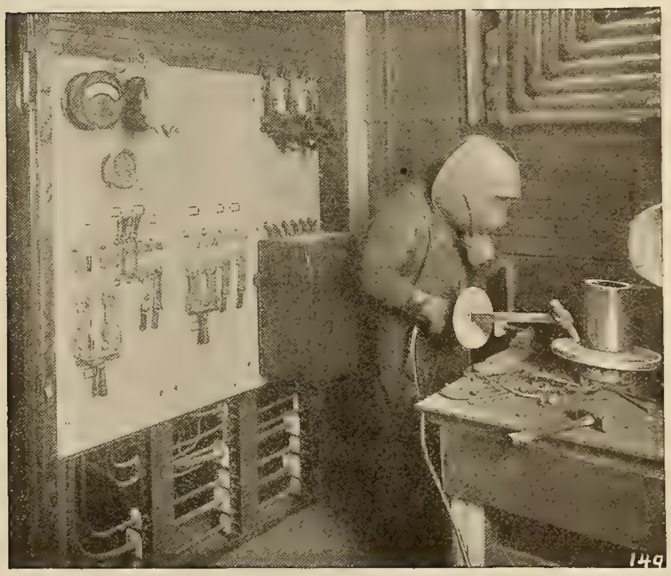
(Electric welding is of particular interest to the central station man. It offers an exceedingly valuable tool for quick repairs when employed by the company operators, and it also offers a profitable new load opportunity for the sales department thrroughout the industrial community served. Here are discussed "down-to-the-minute" ideas on this form of central station load. This paper was delivered before the recent convention of the New Mexico Electrical Association by the author, who is professor of electrical engineering at the state college, which is situated at Las Cruces, N. M.—The Editor.)

ARC WELDING FOR THE CENTRAL STATION

BY R. W. GODDARD

Welding is defined as the intimate and permanent union of two pieces of material. Usually this is accomplished by the application of heat and pressure to the parts to be welded. These two factors are produced in different ways in the several processes used today.

In forge welding, heat is produced in the work from a coal or oil fire while pressure is obtained from the blow of a hammer. In the oxy-acetylene process a gas flame of great concentration and intensity produces the required heat to actually melt the material to be worked, which naturally runs together and becomes a solid mass on cooling. The Thermit process also melts the material and is really a casting method. The process is purely chemical and is based



Repairing Steel Casting with the Lincoln Arc Welder.

upon the fact that metallic aluminum has a great affinity for oxygen and will under proper conditions reduce certain metal compounds, with the production of an intense heat. Finely powdered aluminum is mixed with iron oxide and placed in a crucible over the properly prepared work. This is ignited by a fuse which starts the action. The heat of combination melts the entire mass, the iron liberated from its oxygen sinks to the bottom, while the aluminum united with the oxygen rises to the top. At the right time, the tap in the bottom of the crucible is drawn, allowing the molten iron to flow into the work, firmly uniting it on cooling.

In the electric resistance method of welding, use is made of the heat generated in a conductor of electricity. A contact between two conductors offers greater resistance than the conductors themselves and consequently becomes heated to a higher temperature. This heat is on the passage of a heavy current, great enough to fuse the ends of the conductors together with the help of a little outside pressure. This process uses alternating current and is utilized to a large and ever increasing extent in the industries. A later, process, known as the electric percussion method works upon the same principles but here the process is instantaneous in action and results from the sudden blow of one part upon the other. The pressure is from the blow, while the heat is produced by the sudden discharge of a condenser through the joint to be welded at the instant of impact. Because of the speed of the operation the heat is localized in the joint and does not extend back into either part. This feature is valuable in certain classes of work as well as very economical of the power utilized in the poduction of the wold.

The art of Electric Arc Welding is divided into two general classes, namely: the carbon electrode method, and the metal electrode method, each having slightly different procedures. In either case fusion is the result the intense heat produced by a direct current arc. The arc may be between two electrodes held over the work and be deflected down upon it by magnetic or an air blast as in the Zerener and Werdner processes, (1) or between a single electrode and the work itself as is done exclusively in this country. In the carbon electrode process this single electrode is a carbon rod supported in a suitable holder, while in the metal electrode method it is a metal rod clamped in a feeding tool.

The process of electric arc welding is of particular interest to the central station man as it offers an exceedingly valuable tool for quick repairs with a negligible expense. Its value is chiefly in case of emergency to prevent or shorten the length of an enforced shutdown due to breakage of parts of the equipment or other accidents. Its use is not limited to what has been defined as welding. It will remove superfluous material, and cut sheet metal. It can be used to build up worn bearing surfaces or replace metal worn away in any manner. The innumerable uses to which the process can be successfully applied will suggest themselves to the central station man as they appear. I will, to illustrate the wide field covered, give a few applications which have been brought to my attention.

As examples of the straight weld may be mentioned broken cast iron or steel flanges and lugs, lever and crank arms, and innumerable small but important parts of machinery. More complicated jobs like welding new flues or stay bolts to tube sheets, piecing

old tubes with short lengths of new after they have been removed for leaky joints, repairing cracked mud drums and pipe fittings are successfully accomplished by this process. As these latter jobs require some degree of skill, the novice is warned not to attempt them until he has acquired by practice the necessary skill.

The cutting of sheet metal is one of the most useful applications of this process. Two notable examples of this might well be cited. At the New Mexico College of Agriculture and Mechanics Arts, we had an old rectangular tank built of very heavy sheet iron on an angle frame. This tank was just what was desired for a seasoning tank in the Material Testing Laboratory for concrete test beams, except that it was too deep. The problem was to cut away the top. Because of the springiness of the construction it was practically impossible to cut the sheet with a cold chisel and shearing was out of the question. A hack saw was tried with poor results, a wavy edge and many broken blades. The arc came to the rescue and in a very short time a clean straight line had been burned all the way around the tank, through the angle braces and all.

On Christmas day we had a very heavy wind storm in the southern part of the state. Many roofs and chimneys were blown away and among the latter were two of the three steel stacks of the Las Cruces Electric Light Company. These stacks both buckled about thirty-five feet from the top at the upper guy rings. The buckle extended completely across the stacks effectually cutting off the draught like a damper. The following evening I found Mr. Morgan, the manager, and his crew still trying to clear away the debris and open the standing part of the stacks with a cold chisel. He experienced the same trouble we at the college had with our tank. The cold chisel would bound off at every blow and made no progress. An offer of assistance was made and promptly accepted. I went out to the college, got my carbon welding electrode, lamp bank resistances, and hood and back to Las Cruces. The generator there is a 150 kw. General Electric machine with built in exciter. We removed the alternator field brushes and hooked on to the exciter brush holders, going through the lamp banks to a ground at a water pipe on one side, and on the other led a wire out to the boiler room roof and up the stack. The Corliss engine received sufficient steam to run the exciter from a small auxiliary boiler connected to the third and whole stack. In about four hours time the larger stack was wide open and ready for business. This time would of course been much less had we been able to get more current at the electrode. The fact that the work was some fifty feet in the air and the operator a very green steeple jack on an exceedingly insecure and wabbly ladder also delayed progress. With the large stack open, the plant was started up and with a small motor-generator set brought up from the college the next day, Mr. Morgan burned off the other stack.

These are but two of many possible applications for arc cutting. The removal of rusted bolts and rivets, the dismantling of old pipe lines, the cutting of openings in tanks and boilers for additional pipe connections and many others might be mentioned.

The building up of fresh material is also a notable advantage of this process. Probably the most common use of this feature is in the repair of grates. Holes burned in bars are easily and quickly filled up. It is not even necessary to remove them from the furnace. Worn key ways, cam surfaces, latch catches and tapets are all easily brought up to their original shape. Broken gear teeth may also be replaced. This is especially true of large cast iron gears where the tooth outline does not have to be extremely accurate. Samples of this class of work done at the New Mexico College of Agriculture and Mechanic Arts are broken S wrenches, and a brass gate valve, the whole side of which was broken out by freezing. This was replaced by removing the valve body, filling the shell with moist sand and melting copper into the brass and over the sand core. The S wrench would not seem a practical illustration as the added material has not the strength of the original, although experts claim to have produced welds stronger than the materials welded. At the college we have produced welds which have rebroken at points outside of the weld, but this is not in general true and cannot be depended upon.

Your natural question now is, "What do I need to produce these results?" The answer is simple: a source of direct potential, a current regulating resistance, a carbon or metal rod holder or both, and protective devices for the operator. In central stations the direct current is usually available from an exciter unit. The size of this is of small consequences, except that the larger the better and quicker are the results. At the college we have done successful welding with as small a machine as a three horsepower 110 volt, 24.5 ampere, direct current motor used as a generator and driven by a three horsepower, three-phase induction motor. In practice as large currents as 1500 amperes have been used. This is of course for very heavy work. The average currents used by plants in continual operation will run about 150 amperes for the metal electrode and 300 amperes for the carbon electrode. Regular welding generators are usually built to deliver from 300 to 600 amperes at approximately 60 volts. Any machine can be worked at a considerable overload in this service because of the fluctuating character of the load.

Since the electric arc in itself is unstable, there is necessary in its circuit some current regulating device. This is usually in the form of a low resistance connected in series with the arc. For the central station a suitable resistance is easily and quickly constructed of telephone wire run over porcelain knobs. The size and length of wire used will of course depend on the current desired and the voltage characistics of the generator. Usually an exciter may be connected directly to the arc without any series resistance in the circuit provided it is a compound wound machine and the series field is cut out. In this case the field is working at low flux densities and the armature reaction acts to produce the desired current regulation. This is also true of many shunt generators when working at 50 to 60 volts, but designed to deliver their maximum load at 110 to 125 volts. The exact conditions for any particular machine are best obtained by experiment, but when ex-

perimenting be sure the armature is well protected by fuses or circuit breaker.

The tools required are simplicity in the extreme. The carbon electrode consists of a graphite rod, ½ in. to 1½ in. in diameter, held in a clamp attached to a handle. Connection is made to the clamp by the terminal lug of the negative lead. The metal electrode is much the same, with the exception that it is made to take rods of approximately 3/16 in. diameter. The light from the arc, especially the metal to metal arc, is very rich in ultra violet rays and these cause severe burns if not prevented from striking the operator. A shield or hood protects his face and eyes, while gloves protect the hands. The hood is usually a cylinder of metal or fiber open at the top and bottom for ventilation and fitting down over the shoulders. A window of colored glasses in the front allows the operator to see his work. The glasses should be of sufficient density to prevent glare and eye strain due to the intensity of the light. Experience shows that a combination of green and orange gives the greatest satisfaction, allowing the operator to see the work as well as cutting down the intensity of the light from the arc enough to prevent eye strain. Fiber is to be preferred to metal for hoods as it is an insulator and cooler to work in. A supply of iron rods about 3/16 in. in diameter are needed for filling material or metal electrodes.

The manipulation is as easy as the apparatus is simple. As before stated, the work is made the positive electrode, since from a study of the direct current arc it is found that about 85 per cent of the power used is consumed at this point, thus liberating there the greatest quantity of energy. The generator is adjusted to deliver a potential of 45 volts by the field rheostat. The arc is struck by touching the negative electrode to the work and drawing it away. The length of the arc varies from ⅛ to ¼ in. with the metal electrode and from ½ to 3 or 4 in. with the carbon electrode. The electrode is given a circular motion to prevent too local heating and consequent burning of the work. Filling material comes from the electrode in the metal electrode process, while it is melted in by holding a 3/16 in. rod in the arc of the carbon electrode process. Current is regulated by adjusting the series resistance or the voltage of the generator. In welding thick pieces, the work must be prepared by cutting a V groove along the junction to allow the electrode to work at the bottom, the groove is then filled as the weld is completed. Care should be taken to see that the work is free from dirt and rust. This cleaning can be done by the arc itself if the current is heavy by melting the material and cleaning off the slag which rises to the surface. On large pieces trouble is often experienced with heat expansion and contraction. It is in this case generally desirable to heat the work to a dull red heat before welding. The weld on completion and while still white hot should be hammered as this drives out the gases which form in the molten metal and would otherwise form holes. It also tends to give the weld a denser and finer grain which of course adds to its strength. If possible anneal work after welding as this removes all strains set up by uneven cooling. This is particularly necessary if the work is to be machined.

Work with the carbon electrode is easier for the armature than with the metal electrode because of the necessity of maintaining a very exact length of arc with the latter. If drawn out too far it extinguishes itself, while if the metal electrode is allowed to touch the work it freezes to it. The carbon electrode is particularly adapted for all large work and necessary for cutting. The metal electrode works best on all small work, for building up new material, and for overload work. I believe the metal electrode process is the only one in which overhead work can be successfully done.

The use of flux in this work seems to be a matter of opinion with the operator. Some use it while others do not and produce just as good results. Borax or a mixture of red oxide of iron, 20 per cent, to borax, 80 per cent, are used.

Theoretically all metals may be welded by the electric arc process, but practically this is not true. Difficulty is experienced in preventing oxidation at the welding temperatures with zinc and aluminum. I have heard of aluminum being welded by surrounding the work with an inert gas. This may be done by putting the work in an air tight enclosure open only at the top. This is then filled with some inert dense gas which is confined by its density to the chamber. This can also be successfully accomplished by building a mold about the work and puddling the aluminum in the mold. The oxide then rises to the surface. The filling materials and metal electrodes are usually of the same material as the parts to be welded. For cast iron, malleable iron, and steel, a soft iron or mild steel is used. Recently experimental work has been conducted with success using alloys of steel where great hardness is required as in switch frogs and crossings in street railway work.

The following tables show the cutting speed and current required for steel plates of various thickness, as well as the results of some tests of various welds in iron and steel.

Table 1

Thickness Plate.	Current Amps.	Speed Cutting.
¼ in.	400	180 ft. per. hr.
⅜ in.	400	120 " " "
½ in.	400	50 " " "
¾ in.	400	20 " " "
1 in.	400	10 " " "
¾ in.	600	25 " " "
1 in.	600	16 " " "

Table II.—Results of Tests on Fire Welded and Electric-Welded Specimens

Brand Iron & Steel. Size of Bars. Strength in Tons of 2240 Pounds. Brand.	Size.	Kind Weld.	Ultimate Tensile Strength. Tons/in.²	Contraction of Area at Fracture. Per Cent.	Extension in Ten Inches. Per Cent	Ratio of Weld to Solid. Per Cent.
Lowmoor	2 in. x	Fire	20.4	15.9	8.1	82.3
Iron	3/16 in.	Electric	21.0	15.4	7.3	86.4
Lowmoor	2 in. x	Fire	20.3	15.2	7.3	77.9
Iron	5/16 in.	Electric	21.1	17.3	7.3	81.1
Netherton	2 in. x	Fire	21.5	22.3	11.3	90.7
Best Iron	¼ in.	Electric	21.8	20.7	9.7	91.8
Parkgate	2 in. x	Fire	18.4	10.1	3.4	84.4
Steel	⅛ in.	Electric	20.1	10.8	4.5	92.0
Parkgate	2 in. x	Fire	20.9	9.3	1.9	69.1
Steel	½ in.	Electric	22.3	18.4	3.8	73.6

References:

(1) University Colorado, Journal of Engineering, October, 1916, page 23.

(2) Illumination, Arcs. R. W. Goddard, page 61.

(3) University Colorado, Journal of Engineering, October, 1916, page 32, 33.

Electric Journal. E. S. Zuck, Vol. XI, page 37, Jan., 1914.

Electric Journal. E. S. Zuck, Vol. XI, page 565, Oct., 1914.

WESTERN ELECTRICAL ASSOCIATION MEETINGS

(Activity in affairs of the National Electric Light Association is to be observed on all sides throughout the West. The coming conventions of the Pacific Coast Section in April at Riverside and the Northwest Electric Light & Power Association in September at Spokane are interesting men of the industry on all sides. The convention of the New Mexico Electrical Association during the past two weeks described herein is typical of the happenings that are taking place in all sections of the West.—The Editor.)

CONVENTION OF NEW MEXICO ELECTRICAL ASSOCIATION

The third annual convention of the New Mexico Electrical Association at Albuquerque, Feb. 12, 13, 14, was in every way a success, there being a representative attendance, good papers, fine discussions and a hearty spirit of co-operation. From the social standpoint, also, banquets, a Jovian rejuvenation, round table discussions and a dance, contributed to the enjoyment of the thirty-five men registered.

Delegates and Squaws at the Convention of the New Mexico Electrical Association.

Having rounded out two years, this live organization enters on the third under the capable direction of M. R. Buchanan of Silver City, who is the newly elected president, J. R. Smith of Raton, first vice-president; D. W. Morgan of Las Cruces, first vice-president, and Jas. A. Shepard of Deming, secretary-treasurer. The new executive committee consists of past presidents C. M. Einhart of Roswell and W. P. Southard of Albuquerque; W. F. Ritter of Lordsburg, and Kenneth Myers of Gallup. The papers and discussions will be printed in their entirety, some appearing elsewhere in this issue. A brief summary of the salient points of the meeting follows:

The convention was opened on Monday morning with an address of welcome from M. L. Fox, editor of the Albuquerque Journal, with appropriate response by E. F. Sells. In his presidential address, W. P. Southard told of the past year's accomplishments and suggested a campaign of publicity to acquaint the people with the power companies' side as an object for the year to come.

Monday afternoon J. R. Smith gave a practical talk on "Efficiency in the Operation of an Electric Light Station," laying stress on the necessity for watching and correcting the leaks which increase the fuel bill. S. J. Ballinger read an excellent paper on "What the Power Company Should Tell the Public," his conclusion being "everything that they want to know," with the idea of allaying their groundless suspicions and gaining their confidence. He suggested that the electric meter might well be replaced by a clock if lamps were installed with the understanding that their use cost just so much per hour, depending upon the rate and the size of lamp. Prof. Goddard of the State College read a paper on "Electric Arc Welding for the Central Station," with special reference to the cutting of metals.

On Tuesday morning, J. F. Greenawalt presented a human interest story regarding the history and development of the telephone. L. A. Barley read a paper on "Standard Conduit Installation," the discussion therein being largely concerned with the detection, prosecution and protection against current theft. A. T. Slack spoke on the "Jobbers' Place in the Elec-

trical Industry," clearly demonstrating the necessity of the jobbers.

In the afternoon K. E. Van Kuran told what the electrical manufacturers are doing to help the power companies. A. H. Halloran gave an address on the past work and future plans of the Society for Electrical Development, and at a later date responded to the toast of the National Electric Light Association and its Pacific Coast section and at the Jovian rejuvenation gave the official obligation to the initiates. B. C. Westlake discussed "Transformers and Protective Devices," and Jas. A. Shepard presented a number of interesting operating wrinkles.

On Wednesday morning Prof. J. L. Brenneman read a paper on "Control of Off-Peak Loads," by a variation of the generating frequency. The ensuing discussion brought out the fact that a superimposed current was more practical and greater off-peak power consumption more desirable to the power company. W. O. Vickery read an instructive paper on "Standardization."

In the afternoon E. B. Glazier read a paper on "Relation of the Jobber to the Central Station." The "Question Box" was then opened and various matters discussed at length. The association voted that the Journal of Electricity be recognized as its official organ, passed a resolution endorsing the work of the Society of Electrical Development and adopted resolutions of condolence over the death of W. N. Berry, who had been elected secretary-treasurer. F. P. Woods paper on "The Meter and the Public" was read by title. Officers and executive committee for the ensuing year were regularly elected and a vote of thanks extended the retiring officers. In the absence of President-elect Buchanan, Vice-President J. R. Smith took the chair and briefly outlined tentative plans for the new year. Upon special request A. H. Halloran told how the association might conduct a campaign for bettering public relations in accordance with methods approved by the Society for Electrical Development. Some such action will be taken by the association this year, all the larger companies now being members of the Society. There being no further business the convention adjourned.

Social Features

The annual banquet of the association was held on Monday night at the Alvarado, J. F. Greenawalt being toastmaster. Other responses were made by H. A. Hibbard, the man of the watches; J. J. Cooper, J. A. Shepard, W. P. Southard, J. R. Smith, E. F. Sells and D. K. Sellers The menu and toasts were announced on a unique "load curve" in blue print form.

On Tuesday night six candidates were initiated in the Jovian Order by the "substitute ritual." J. J. Cooper told of the history and ideals of the order. Particular credit is due to H. A. Hibbard and E. A. Thiele for their efforts in conjunction with the rejuvenation and the joviation which followed, at which W. P. Southard presided. The following candidates were rejuvenated: Wm. W. Reddie, Sidney J. Ballinger, W. O. Vickery, W. F. Ritter, E. J. Van Buskirk and Chas. E. Twogood.

An enjoyable dance at the Alvarado on Wednesday night brought the festivities and activities of the convention to a pleasant close.

Those registered were as follows:

Prof. Reo. Goddard, State College, Las Cruces, N. M.
F. Schram, Roswell G. E. Co., Roswell, N. M.
Chas. E. Twogood, Albuquerque G. E. Co., Albuquerque, N. M.
John G. Koogler, Las Vegas L. & P. Co., Las Vegas, N. M.
S. J. Ballinger, Trinidad G. E. R. & T. Co., Trinidad, Colo.
W. O. Vickery, T. G. E. R. & T. Co., Trinidad, Colo.
Wm. W. Reddie, Western M. E. Co., Pittsburg.
B. E. Rowley, Hot Point, Denver.
—. Wightman, Trinidad G. E. R. & T. Co., Trinidad.
Prof. J. L. Brenneman, University of New Mexico, Albuquerque.
H. H. Jones, Cleveland Akron Bay Co., Cleveland.
Geo. Roslington, City Electric Co., Albuquerque.
A. H. Halloran, Journal of Electricity, San Francisco.
D. W. Morgan, Las Cruces Elec. Lt. & Ice Co., Las Cruces N. M.
J. R. Smith, Raton El. Lt. & Power Co., Raton, N. M.
C. M. Einhart, Roswell Gas & Elec. Co., Roswell, N. M.
E. A. Thiele, Roswell Gas & Elec. Co., Roswell, N. M.
L. A. Barley, Rocky Mountain Fire Underwriters, Denver, Colo.
W. P. Southard, Albuquerque Gas & Elec. Co., Albuquerque, N. M.
M. Nash, Nash Electric Co., Albuquerque, N. M.
H. A. Hibbard, Century Bldg., Denver, Colo.
B. C. J. Wheatlake, General Electric Co., Denver, Colo.
E. C. Armstrong, Nunn Elec. Co., Amarillo, Tex.
E. F. Sells, Westinghouse E. & M. Co., El Paso, Tex.
W. F. Ritter, Lordsburg Power Co., Lordsburg, N. M.
Jas. A. Shepard, Deming Ice & Elec Co., Deming, N. M.
E. B. Glazier, Krakauer, Zork & Moye, El Paso, Tex.
John J. Cooper, Mountain Elec. Co., Denver, Colo.
Thos. Marron, The Southwestern Mill & Elec. Co., San Marcial, N. M.
W. Albertson, New England Elec. Co., Denver, Colo.
A. T. Slack, Western Elec. Co., Denver, Colo.
P. Cameron, Albuquerque Foundry & Mch. Works, Albuquerque.
J. L. Nunn. Nunn Elec. Co. Amarillo. Tex.
F. W. Fisher, Fairbanks, Morse & Co., Albuquerque, N. M.
N. R. Stansel, Southwest General Elec. Co., El Paso, Tex
J. F. Greenawalt, Mountain States T. & T. Co., Denver, Colo.

CCNVENTION OF PACIFIC COAST SECTION OF N. E. L. A.

Preparations for the convention of the Pacific Coast Section N. E. L. A., which is to meet at Riverside April 19, 20, 21, as announced in the last issue of the Journal, are growing apace.

A. B. West of the Southern Sierras Power Company, who is chairman of the committee on arrangements, held a meeting of his committee in Los Angeles, announcements concerning which will be given at a later date. The convention committee is as follows:

A. B. West, general chairman, and chairman entertainment committee, The Southern Sierras Power Co.
W. L. Frost, chairman attendance committee, Southern California Edison Co.
E. B. Strong, chairman transportation committee, Journal of Electricity.
W. W. Briggs, chairman reception committee, Great Western Power Co.
Henry Bostwick, chairman publicity committee, Pacific Gas & Electric Co.
D. M. Speed, chairman finance and auditing committee, San Joaquin Light & Power Corp.
G. B. McLean, Pacific Light & Power Corp., Los Angeles.
L. M. Klauber, San Diego Consolidated Gas & Electric Co.
E. R. Northmore, Los Angeles Gas & Electric Corporation

A committee of thirty, to be known as the membership committee of the Pacific Coast Section of the National Electric Light Association, is being appointed by President Ballad. Those members who have been appointed thus far are the following:

W. W. Briggs, chairman, Great Western Power Co., San Francisco, Cal.
C. A. Luckenbach, Los Angeles Gas & El. Co., Los Angeles, Cal.
Samuel Kahn, Western States Gas & Elec. Co., Stockton, Cal.
L. F. Galbraith, Pacific Gas & Elec. Co., San Francisco, Cal.
W. L. McKinley, Sierra & S. F. Power Co., San Francisco, Cal.
W. S. Coleman, Pacific Gas & Elec. Co., San Francisco, Cal.
S. J. Lisberger, Pacific Gas & Elec. Co., San Francisco, Cal.
W. F. Frost, Southern Cal. Edison Co., Los Angeles, Cal.
E. A. Quinn, San Joaquin Lt. & Pr. Co., Fresno, Cal.
Frank R. Russell, Tucson Gas, Elec. Lt. & Pr. Co., Tucson, Ariz.
J. B. Mechling, Nevada-California Pr. Co., Goldfield, Nevada.
Jas. A. Shepard, Deming Ice & Electric Co., Deming, N. M.
R. C. Lane, Upper Verde Public Utilities Co., Clarkdale, Ariz.
Ross B. Mateer, Southern Sierra Power Co., Riverside, Cal.
B. G. McBride, Elko-Lamoille Power Co., Elko, Nevada.
R. S. Arthur, Douglas Traction & Light Co., Douglas. Ariz.
R. S. Masson, The Arizona Power Co., Los Angeles and Prescott.
R. E. Fisher, Pacific Gas & Electric Co., San Francisco, Cal.
Geo. B. Furness, Pacific Gas & Elec. Co., Oakland, Cal.

Great things are expected of this committee. Composed as it is of the livest and most enthusiastic group of Pacific Coast electrical men it is confidently expected by all that an unusual return will be made in new members by the time the convention opens in April.

SPOKANE CONVENTION OF N. E. L. AND P. ASSOCIATION

The Davenport Hotel at Spokane

PRESIDENT OSBORN of the Northwest Electric Light & Power Association has issued the call for the convention of the association which is to meet in Spokane during September of this year.

Spokane is beautiful at this period of the year and its location at the center of the great Inland Empire surrounded by agricultural and mining development, and nurtured by hydroelectric enterprises on all sides offers an unusual opportunity for a proper setting for the convention activities.

The text of President Osborn's call is as follows:

I have to announce appointments made at a meeting of the program committee in Portland, Oregon, on January 26, 1917, for the convention to be held in Spokane, Washington, on September 12, 13, 14 and 15, 1917, as follows:

Program Committee

M. C. Osborn (Chairman), The Washington Water Power Co., Spokane.
L. A. McArthur, Pacific Power & Light Co., Portland.
A. C. McMicken, Portland Railway, L. & P. Co., Portland.
M. T. Crawford, Puget Sound Traction, L. & P. Co., Seattle.
J. S. Thornton, Willapa Electric Co., Raymond.

Besides the above named, the following gentlemen were present at the meeting, and assisted in the arrangement of the program:
W. J. Grambs, Puget Sound Traction, L. & P. Co., Seattle.
P. A. Bertrand, Grays Harbor Railway & Light Co., Aberdeen.
C. R. Young, Pacific Power & Light Co., Portland.

The program as laid out by your committee, as far as can be determined at this date, will, of course, be subject to changes due to reasons that cannot be foreseen at this time.

In the preparation of the program, it was decided by the committee that all papers should be of a composite nature, with an editor-chairman for each and assistants selected from the best talent we can secure from the various member companies, on the subjects to be discussed.

To prevent duplication of ideas, the editor-chairman of each paper will present for the association's deliberations the ideas of the various members of his committee in one paper, the main idea being to eliminate all theories and confine ourselves to results obtained in practice.

The Program

The Washington association of electrical contractors and dealers, which anticipates an attendance of 100, will hold its annual convention at the same time and place, (The Davenport Hotel), that we hold ours and will have a joint meeting with our association at the opening session, Wednesday, September 12, at 10:00 a.m., at which time the usual address of welcome by our mayor, a response, an address by the president of the association and the reports of committees, will be presented, and a paper by J. C. Ralston, a member of the American Society of Civil Engineers, entitled "Aphorisms."

Wednesday, September 12, 2:00 p. m.

Paper, "Practical Central Station Salesmanship."
Lewis A. McArthur (Editor-Chairman), Pacific Power & Light Company, Portland.
George Bowen, Northwestern Electric Co., Portland.
S. A. Hoag, Puget Sound T., L. & P. Co., Seattle.
H. W. Lines, Portland Ry., L. & P. Co., Portland.
Lewis A. Lewis, Washington Water P. Co., Spokane.

Thursday, September 13, 10:00 a. m.

George E. Quinan (Editor-Chairman), Puget Sound T., L. & P. Co., Seattle.
E. H. Le Tourneau, Portland Ry., L. & P. Co., Portland.
A. S. Hall, Pacific Power & Light Co., Pasco.
D. F. Henderson, Washington Water Power Co., Spokane.
L. T. Merwin, Northwestern Electric Co., Portland.

Thursday, September 13, 2:00 p. m.

Paper, "How the Engineer Can Assist the Commercial Department."
Paper, "Co-operation in Modern Home and Apartment House Wiring Practice."
A. C. McMicken (Editor-Chairman), Portland Ry., L. & P.. Co., Portland.
H. H. Scofield, Pacific Power & Light Co., Portland.
J. R. King, Puget Sound T., L. & P. Co., Seattle.
F. O. Broili, Northwestern Electric Co., Portland.
Foster Russell, Washington Water Power Co., Spokane.

Friday, September 14—Both Sessions

Range Committee.—Both sessions of Friday will be devoted to the report of the range committee. I am pleased to announce the acceptance of the chairmanship of this committee by Mr. W. R. Putnam of the Utah Power & Light Company, Salt Lake City, Utah. Mr. S. M. Kennedy of the Southern California Edison Company, Los Angeles, and Mr. S. V. Walton of the Pacific Gas & Electric Company, San Francisco, Cal., will also act on this committee the exact personnel of which, however, will be announced later by its chairman, Mr. W. R. Putnam.

In connection with the range committee report, a paper will be read by Mr. H. B. Peirce of The Washington Water Power Company, Spokane, Washington, on "Bus-Bar Diversity of Ranges" compiled from data gathered from the study of residential feeders and other sources.

Also a paper by Mr. B. L. Steele, professor of physics at the Washington State College, Pullman, Washington, entitled "Comparative Tests of Coal, Kerosene and Electricity for Cooking."

(a) "Cost of Typical Meal for Five Persons by Coal and by Electricity";

(b) "Cost of Cooking for Five Persons One Week, by Coal With Water-Back Attachment and Without Water-Back Attachment, and With Electricity";

(c) "Efficiency Tests on Coal Ranges, Kerosene Burners and Various Electric Ranges."

The "Experience and Wrinkles" paper read at the convention two years ago in Spokane, was thought to be of a great deal of value to the association and will be revived this year, edited by Lewis A. Lewis of The Washington Water Power Company, Spokane. The value and usefulness of this paper depends upon the entire membership of the association.

Spokane Won't Look Like This at the September Convention

A "Wrinkle" is defined as being "any device, short cut, method or experience which has been worked out and used to advantage in carrying out your business."

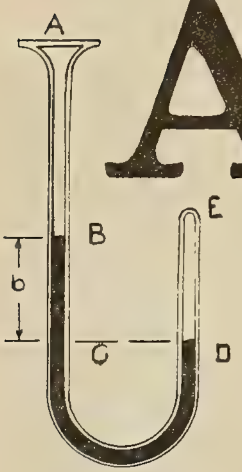
It is our intention to continue this broad definition and we are asking for contributions from as many departments and members as possible. There are many men connected with this association that have commendable ideas which cannot be elaborated into papers; these ideas properly come under the heading of "Wrinkles."

FUEL OIL AND STEAM ENGINEERING

(The laws of thermodynamics are so abstract, as a rule, that their meaning shoots clear over the head of the student in engineering application of these laws. In this article the author sets forth the elementary laws of thermodynamics used in fuel oil and steam engineering practice in such a way, it is believed, as to make them of ready application in all the simpler uses to which they may be put. With a clear conception of temperature and heat as herein set forth, one should be enabled to compute volumes and pressures of gases as occasion may arise.—The Editor.)

THE ELEMENTARY LAWS OF THERMODYNAMICS FOR FUEL OIL PRACTICE

BY ROBERT SIBLEY



The Establishment of Boyle's Law

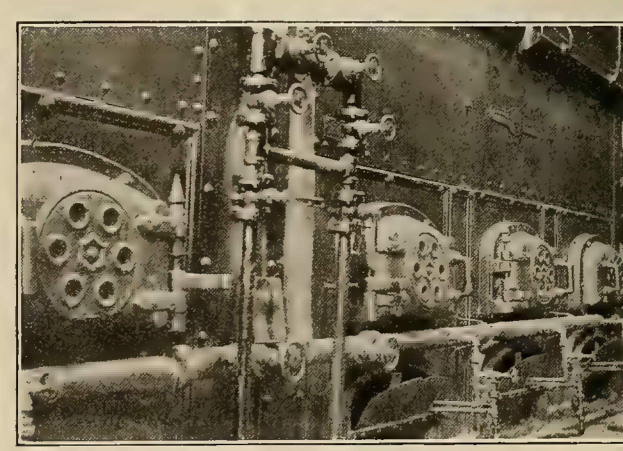
As pointed out in the discussion on temperatures, scientists in former times conceived that the phenomena accompanying the addition or subtraction of heat could only be explained by the existence of a fluid which they called "caloric."

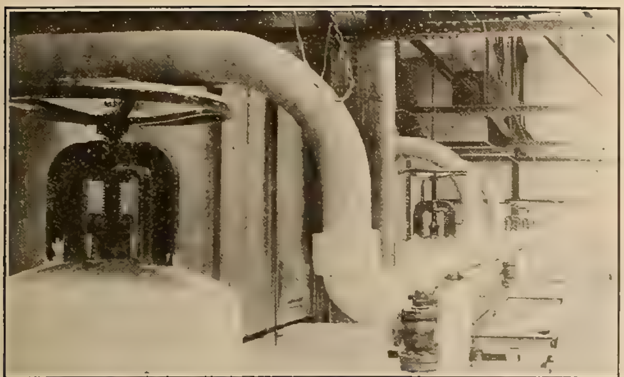
But these scientists or calorists, as they were called, had to give a hitherto unknown property to their substance and maintained that "caloric" was a weightless fluid. This substance also had the property of filling the interstices of bodies and of passing between bodies over any intervening space. To illustrate, they said, "caloric" would fill the interstices of a body as water enters a sponge. Now, when we squeeze a sponge some of the water oozes out and wets our hands. The calorists assumed that the friction or rubbing of a body with the hand for instance, made the hand warm because friction was supposed to decrease the capacity of a body for holding "caloric," and as in the squeezing of the sponge, water oozes out, so caloric oozed out and made the hand feel warm.

The Irrefutable Experiments of Davy.—Davy, however, exploded this theory in 1799, when by rubbing two pieces of ice together, he actually caused the ice to melt. This evidently would be impossible under the caloric theory above stated, according to which friction caused capacity for caloric to be decreased. Yet here was evidenced the adverse. From time immemorial, men have considered that the force of truth is almighty, and yet how slow the human race is to overthrow an imperfect but well-established theory. For instance, so powerful was Sir Isaac Newton's grip on the scientific world that because he announced that no successful correction could ever be made for the uneven refraction of light rays in lenses, the whole world for fifty years thoroughly abandoned the idea of ever being able to use refractive telescopes, and consequently, during that period we find telescopic reflective mirrors used entirely.

Joule's Complete Demonstration of the Mechanical Equivalent of Heat.—And so it was in the case of the theory of heat. Notwithstanding the all-powerful demonstration of Davy in 1799, it remained for Joule, nearly fifty years later to finally put forth the finishing data to forever overthrow the caloric theory and introduce the modern idea of heat. This eminent scientist constructed a machine in many respects similar to an ice-cream freezer, the essential difference being, however, that the machine was used to increase the heat in the liquid instead of cooling the same. Joule conceived the idea that heat was one form of energy. Should this be true, it should be mutually convertible. One of the easiest methods of measuring energy is the well known pile driver. Energy is definitely computed by weighing the hammer in pounds and multiplying this weight by the distance in feet through which the weight falls. The result is foot pounds energy. By a clever contrivance constructed somewhat on this principle, Joule measured the amount of energy absorbed in his machine and the consequent rise of temperature in the liquid. He soon established the fact that a definite number of foot-pounds of mechanical energy was equivalent to a definite number of heat units in the liquid. This experimental result is most important and is one of the basic principles of modern engineering. Careful scientific measurements have proved that one British thermal unit, or B.t.u. of heat energy is equivalent to 777.5 foot-pounds of mechanical energy.

The First Law of Thermodynamics.—From this discussion it follows that the first and greatest law of thermodynamics is the mathematical expression of the fact that heat energy and mechanical energy are mutually interchangeable. Thus if **W** represents energy in foot-pounds; **H**, energy in heat units; and **J**, this experimentally determined constant, we have the relationship


The Furnace Gases and Entering Air Obey Rigid but Simple Thermodynamic Laws. (Boiler Fronts at Long Beach Plant of the Southern California Edison Company.)



Superheated Steam Approximately Obeys Simple Thermodynamic Laws, (Superheated Steam Ducts of Station C of the Pacific Gas & Electric Company in Oakland.)

$W = HJ$ ....(1)

In steam engineering practice **H** is usually expressed in B.t.u. and the quantity **J** has a value of 777.5 as has been stated above. In other words, 1 B.t.u. of heat energy is equivalent to 777.5 ft. lb. of mechanical energy. In the chapter on units, we have defined the fundamental unit of energy, namely the foot-pound. This unit of heat energy now introduced, known as the British thermal unit is the 1/180th part of the heat necessary to raise one pound of water from 32° F. to 212° F. under standard atmospheric conditions of pressure. This is the unit which has been adopted by Marks and Davis, in their "Steam Tables and Diagrams" and although differing from other previously existing units is nevertheless practically universally adopted at this time.

Boyle's Law. Early in the last century, Boyle established the fact that a perfect gas, such as air, follows very closely the law known as Boyle's law, that the product of its pressure and volume is always constant provided the temperature is kept constant. Expressing this in mathematical symbols, if **p** is the absolute pressure in lb. per sq. ft.; **v**, the volume in cu. ft. occupied by 1 lb., we have the relationship

$p\,v = p_0\,v_0$ ....(2)

Steam is not a perfect gas and hence does not obey this law with exactness, still the formula may be used with a fair degree of accuracy when considering superheated steam. Accurate formulas will be given later for steam variation. As an instance, however, of approximate computation, let us consider a boiler operating at 186.3 lb. gage or 201 lb. absolute pressure per sq. in., and producing superheated steam at 527° F. If we know the volume at one pressure we may ascertain approximately the volume at another pressure. In the steam tables the volume of steam at 201 lb. pressure per sq. in. is found to be 2.83 cu. ft. per lb. Hence at 250 lb. pressure the volume would become

$v = \frac{200 \times 2.83}{250} = 2.26$ cu. ft. per lb. The steam tables give this quantity by actual experiment as 2.31. Hence the formula is seen to work with superheated steam within 2 per cent of accuracy. For chimney flue gases and air, however, Boyle's law is very exact.

Charles' Law. In 1806 another law was found connecting the variables of a perfect gas. This great law, known as Charles' Law sets forth the fact that when the pressure is kept constant the volume of a gas increases proportionately to the increase in temperature. Thus if **t** is the temperature in degrees Fahrenheit this law states that

$$v = v_0\,(1 + \frac{t - 32}{491.6}) \qquad (3)$$

As an illustration, if we wish to compute the volume that 1 lb. of air would occupy in a furnace at 2100° F., knowing that v_0 has a value of 12.39 cu. ft. for air at 32° F. then $v = 12.39\,(1 + \frac{2100 - 32}{491.6}) = 69.8$ cu. ft.

The Absolute Scale. The establishment of this law indicates the fact that all temperatures should naturally be measured from a point other than that of the freezing temperature of water. Thus it is seen from the above that a point of 459.6° below the ordinary Fahrenheit scale would be known as an absolute zero. Throughout this work then **T** will represent the absolute scale and **t** the ordinary scale. Thus

$T = t + 459.6$ ....(4)

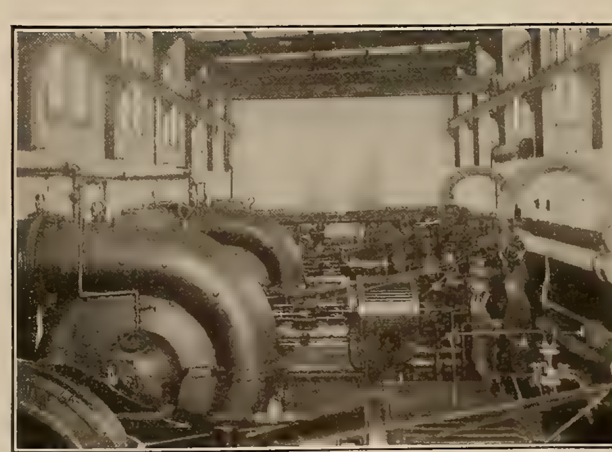
The Composite Law of Gases.—Since it is seen that the product of the pressure and volume is proportional to the change in absolute temperature we shall now write one of the most useful formulas in the computation of gas constants, namely that

$pv = RT$ ....(5)

in which **R** is a constant.

In the case of air, let us see if we can compute this constant. Experimentally it is found that the volume of air in a boiler room temperature of 84° F. is 13.71 cu. ft. per lb. when the atmospheric pressure is 14.7 lb. per sq. in. Substituting in the above formula we have $14.7 \times 144 \times 13.71 = R\,(459.6 + 84)$. Therefore $R = 53.3$.

A Formula for Gas Density.—If we let γ be the density of a gas, it is evident that it has a value equal to the reciprocal of **v** in the above equation In other words the density of a gas is the weight of 1 cu. ft under standard conditions of pressure and temperature. We may then write without further proof the formula,



Saturated Steam Obeys not at all the Simple Laws of Thermodynamics. (Circulating Water Pumps Operated by Saturated Steam at the Redondo Plant of the Pacific Light & Power Corporation.)

$$R\gamma = \frac{p}{T} \quad \ldots\ldots (6)$$

To Compute "R" for Any Gas.—In the measurement of gases there is a standard pressure and temperature to which all gas volumes and densities are reduced in order to have some basis of comparison. These standard conditions are the temperature of freezing water and the pressure of the atmosphere at sea-level.

From the equation last written above, it is now evident that since **p** and **T** are constant for all gases under this standardized method of comparison, then the product of **R** and γ must also be constant. This gives us a method or rather formula by which we may obtain the value of **R** for any gas if we know its molecular weight. The molecular weights of all gases may be obtained by reference to any standard book on elementary chemistry.

Let us multiply both sides of the above equation by the molecular weight **m** and by rearranging the terms, we have

$$Rm = \frac{pm}{\gamma T}$$

For oxygen $\gamma = 0.089222$ lb. per cu. ft. at atmospheric pressure and 32° F. and $m = 32$.

$$\therefore Rm = \frac{14.7 \times 144 \times 32}{0.089222 \times 491.6} = 1544.$$

Since this product **Rm** is always a constant, we have for any perfect gas that

$$R = \frac{1544}{m} \quad \ldots\ldots (7)$$

This formula together with the preceding general formulas for pressures and volumes now enables us to ascertain practically all the constants for perfect gases.

As an example let us assume that the temperature of an escaping chimney gas is 400° F. What would be the density of the nitrogen content of the escaping flue gases? First find the value for **R** for nitrogen for which $m = 28$.

$$\therefore R = \frac{1544}{28} = 54.98$$

Hence since

$$R\gamma = \frac{p}{T}$$

$$\text{We have } 54.98\,\gamma = \frac{14.7 \times 144}{459.6 + 400}$$

$$\therefore \gamma = .04475$$

It is always convenient to express volumes as the number of cu. ft. per lb. Hence when the symbol **V** is used it will mean the total volume content of the gas under consideration. If **M** represents the weight of this volume **V** we have the relationship

$$Mv = V \quad \ldots\ldots (8)$$

or since $pv = R \times T$, therefore

$$pV = M \times RT \quad \ldots\ldots (9)$$

Thus if we have given 18.805 lb. of dry flue gas we can easily compute the volume it would occupy when leaving the chimney at 400° F., if it is known that the value of **R** for the chimney gas is 51.4. Thus

$$14.7 \times 144\,V = 18.805 \times 51.4 \times (400 + 459.6)$$

$$\therefore V = 393.5 \text{ cu. ft.}$$

Further Illustrative Examples.—In order to still further illustrate the wide uses to which the formulas above given may be applied in engineering practice, the following seven problems are worked out in full:

1. Find the volume of one pound of air in a compressor at a pressure of 100 lbs. square inch, the temperature being 32° F.

From Boyle's Law:

$$pv = p_o v_o$$

at 32° F., v_o for 1 lb. of air is 12.39 cu, ft. and $p_o = 14.7 \times 144$

$$\therefore v = \frac{14.7 \times 144 \times 12.39}{100 \times 144} = 1.82 \text{ cu. ft.—Ans.}$$

2. From Charles' Law find the volume of one lb of air at atmospheric pressure and 72° F.

$$v = v_o\left(1 + \frac{t - 32}{491.6}\right) = 12.39\left(1 + \frac{72 - 32}{491.6}\right) = 13.4 \text{ cu. ft.—Ans.}$$

3. Find the temperature of two ounces of hydrogen contained in one gallon flask and exerting a pressure of 10,000 lbs. per sq. in.

2 oz. = 1 gal.

16 oz. = 1 lb. or 8 gals = 1.068 cu. ft.

$$\text{Then } T = \frac{pv.}{R} = \frac{10{,}000 \times 144 \times 1.068}{765.86}$$

$$\therefore T = 2050° \text{ F. (abs.)—Ans.}$$

$$\text{or } t = 2050 - 459.6 = 1590.4° \text{ F.—Ans.}$$

4. How large a flask will contain 1 lb. of Nitrogen at 3200 lbs. per sq. in. pressure and 70° F.?

$p = 3200 \times 144$, $T = 459.6 + 70 = 529.6$, $R = 54.98$

$$pv = RT \qquad v = \frac{RT}{p}$$

$$\therefore v = \frac{54.98 \times 529.6}{3200 \times 144} = .0631 \text{ cu. ft.—Ans.}$$

5. Ten lbs. of air at 200° F. occupy 120 cu. ft. What must be the pressure?

$V = 120$
$M = 10$
$R = 53.33$
$T = 659.6$

$$\therefore p = \frac{MRT}{V} = \frac{10 \times 53.3 \times 659.6}{120} = 2950 \text{ lb. per sq. ft. —Ans.}$$

6. How many lbs. of air does it take to fill 5600 cu. ft. at 15 lbs. per sq. in. pressure and 60° F.?

$$pV = MRT$$

$V = 5600$ $p = 15 \times 144$ $R = 53.3$ $T = 459.6 + 60 = 519.6$

$$\therefore M = \frac{15 \times 144 \times 5600}{53.3 \times 519.6} = 437 \text{ lbs.—Ans.}$$

7. At what temperature will ten lbs. of CO_2 at 15 lb. per sq. in pressure fill 60 cu. ft.?

$$pV = MRT \qquad R = \frac{1544}{m} = \frac{1544}{44}$$

$p = 15 \times 144$, $V = 60$, $M = 10$. $\therefore R = 35.09$

$$\therefore T = \frac{pV}{MR} = \frac{15 \times 144 \times 60}{10 \times 35.09} = 369.2° \text{ F. (abs.)—Ans.}$$

$$\therefore t = T - 459.6 = 369.2 - 459.6 = 90.4° \text{ F.—Ans.}$$

SPARKS—Current Facts, Figures and Fancy

(A little here and a little there, gradually absorbed, is the way most of us build up our store of knowledge and acquire ideas for new enterprises in our respective lines. From this page may be gleaned perchance, something that may serve you in inspiration and creative imagination for the tasks ahead of you.—The Editor.)

Says the Bureau of Safety at Chicago: "You bet your life when you are thoughtless and careless about your work."

* * *

Why not think more earnestly of the wise saying of Jim Hill the Empire Builder: "Men who succeed are not magicians, but they have a capacity for hard work. If causes are created, effects must come."

* * *

The great German poet, Goethe, sent forth a truism that may well be called to mind in every effort electrical as well as in the other affairs of men: "The great part is not to pull down but to build up, and in this humanity finds pure joy."

* * *

Next to electric current, the most serious accidents are caused by falls and also the greatest number of days' lost time may be charged to this cause. This enters into every branch of the work, construction, operation, distribution and even the office.

* * *

First has come the use of radium salts to illuminate the hands of a watch so that time is easily told in the darkest surroundings. Now comes the same application for all kinds of push button apparatus, making it possible for a person to easily locate push buttons and other objects in an unlighted room.

* * *

By midsummer two mills having a total daily capacity of handling four hundred tons of tungsten ore deposits in Inyo County of California will have been completed and put in active operation. It may be that electric lamp companies will some day get all their supply for Western markets from Western sources. Who knows?

* * *

The latest in mammoth industrial centralization activity has recently been proposed by the Southern Pacific Company. This company offers to trade the city of San Francisco certain valuable lots on Van Ness avenue for the city's holdings on Channel street where the company would invest ten million dollars for creating manufacturing, wharfage and depot facilities on a scale hitherto unattempted in the West.

* * *

Lithographic stone, due to the high cost of quarrying and preparing for competition with the well-known Bavarian stones has been produced but little in the United States in the past. Kentucky stone is now profitably entering the market at five to six cents per pound for ten by twelve inch slabs and poorer grades, at one and one-half cents a pound for slabs of the same size. Why should not the West with its exceptional power rates and undeveloped quarries now enter this market?

* * *

The International Institute of Agriculture, since making an extended investigation as to whether the world has enough to live on during the coming year after taking into account the coming harvests in the southern hemisphere, reports that the whole world's surplus for the five great cereals will be about two-thirds of a billion bushels and the total surplus at the disposal of international trade as over fifty million bushels. Consequently it looks as if we might all pull through another year.

* * *

Electrical operation of trains entering long tunnels may find another application soon. General Chittenden, a retired member of the U. S. Engineer Corps, now chairman of the Port Commission of Seattle, Wash., has projected a plan to drive a thirty-mile tunnel under the Cascade Mountains to improve traffic facilities between ports on Puget Sound and the interior of the state. Such a project might cost fifty million dollars, but it would save fifty-eight miles of haul, reduce the summit elevation by over two thousand feet and the maximum grade from two and two-tenths to but six-tenths of a per cent.

* * *

Roy Thompson, a youth of Sacramento, California, is said to have invented an electrical device, which by means of two masts, seventy-five and one hundred fifty feet high, and eighteen hundred feet of barbed wire in the aerial, can operate a specially wound motor so that his home may be illuminated. That wireless transmission of power is possible has been known for some time and it is believed inventors will some day bring out a useful and efficient method of application. We must remember, however, that this energy can not be pulled out of the air without having some reservoir of supply whence it comes.

* * *

Due to the frequent indifference for small crops and diversified production found among Argentine farmers that country, in spite of being a primarily agricultural country, is dependent to a large extent on imports for its supply of beans, peas, and chick-peas. How our South American neighbors would hasten to install electrical pumps for irrigation if they heard of the high cost of beans said to prevail in Sacramento, California, recently, where a bartender is said to have taken up the three beans thrown on the counter by his customer, rung-up fifteen cents on the cash register for the drink furnished and returned eighty-five cents in change!

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CONTENTS

IF IT'S WAR, HOW ABOUT YOU?

Engineers of the West see in the ultimate fruition of their present peaceful pursuits a creation that will raise the standard of human happiness and ease the burdens that attempt to crush the human race. If, however, for a season we must seemingly put aside our labors of peace to assume the sombre sober role of national defense let us do it bereft of hatred, with charity toward all and apply to the reharmonizing of world forces that same hearty, joyous, life-giving effulgence so characteristic of the freedom we breathe on every side in our Western Empire. Let us remember that in the last analysis mankind can only reach the harmony of being when freed from dominating influence both at home and abroad.

Bank Acceptances in the Electrical Industries

Much discussion has recently taken place in the columns of this journal relative to the use of bank acceptances in the electrical industry. On another page of this issue will be found a form advised by the Federal Reserve Commission.

In the local uses among contractors and dealers the acceptance is each day proving its usefulness in broadening the working capital and speeding the number of times of "turn over" of this capital during the year.

In the foreign field the American bank acceptance is a novelty in the commercial life of the country. According to a prominent banker of New York City, the commercial community of the United States has for years been deprived of the use of this most essential instrument of commerce due to the peculiar laws that have been in existence for years past. This same authority goes on to state that the potentiality of this new instrument is incalculable, and as time goes on its benefits will be appreciated far and wide.

A list of over one hundred and fifty articles of merchandise has been brought into this country last year by means of commercial letters of credit representing a total valuation of over thirty-five million dollars.

The value to the West of the future development of the letter of credit business is of vital importance in engineering and commercial life both at home and in all countries bordering the Pacific.

Improved Engineering and Banking Facilities

The recent authorization given the Federal Reserve Bank of New York to appoint the Bank of England as its agent in London and the probable appointment of the Bank of France as agent in Paris, and other foreign agents through Europe in all likelihood will be followed in time by the appointment of strong financial institutions in similar capacities in Japan, China and Australia. In South America, too, the American banking facilities have long kept back American commercial and engineering enterprise. It is to be hoped the authorization of branch banks will be made in this direction also.

In normal times the arrangement above perfected with European institutions will undoubtedly add much in stabilizing exchange rates and preventing the movement of gold.

But now is the time for better banking facilities with countries bordering the Pacific. As pointed out in a recent issue of the Western Banker and Financier, increased financial facilities with countries bordering the Pacific will probably be far more effective at this time than at the close of the war. Bankers in these countries are still making their bills of exchange on London and it is with a view toward diverting a part of this business to the United States, that the establishment of agencies in Pacific lands is at present informally under consideration.

The strong financial institutions of San Francisco, Los Angeles, Portland and Seattle can aid much in forwarding closer engineering and commercial relations with these countries if only given the opportunity. The problem before the West is the arousing of sufficient public sentiment to stir the national board to action. And careful reasonable public expression on the part of engineers of the West urging the establishment of these Pacific branches will add its share in bringing about this commercial freedom so necessary for growth of Western commercial and engineering enterprise.

Why the Pacific Coast Section of N. E. L. A.

Now that the campaign for new members for the Pacific Coast Section of N. E. L. A. is well under way, it is not amiss for all interested to stop a moment and weigh the reasons that are impelling men of highest engineering and executive ability in the West to support this movement.

The peculiar engineering and commercial problems that exist West of the Rocky Mountains, so wholly different from those that prevail in the more populous districts to the east, are the all impelling motives that lead these men to action.

In this section of the country the insulation problems, the standardization of transformers, the specifications for overhead construction, and many other questions of engineering and commercial interest are so at variance with Eastern practice that in some instances Eastern manufacturers have classified apparatus furnished as "special." Indeed it has not been infrequent in occurrence that questions with answer blanks sent out from the New York office as thought to represent common practice in the electrical industry have proven so foreign to Pacific Coast practice as to prove wholly unanswerable due to non-use of the methods indicated in the forms.

Then again there is the matter of close co-operation of neighboring companies and an over and above board medium for frank comparison of methods and ideals to be realized. The company section has proved too "in-breeding" to attain the broad results desired. The geographical section on the other hand combines close proximity and its consequent community of interest with sufficient instilling of fresh outside thought. Under this method of organization all problems under discussion reach an ideal setting hardly realizable under any other method of organization of sub-sections of the national association.

Those having in charge the fathering of this movement are preparing two main committees for action—the commercial and the engineering. The membership committee, constituting a third necessary division of effort is now actively engaged in gathering in new enthusiasts for the discussions to come later.

The organization proposed is good and wholesome. It has the backing of those who have the interests of the electrical industry of the West nearest at heart. Are you doing your part?

The Possibilities of Regenerative Application

The beautiful results of regenerative braking that are daily being accomplished on the Rocky Mountain Division of the Chicago, Milwaukee and Puget Sound Railway through Idaho and Montana are not only gratifying to the proponents of the scheme but indeed every thoughtful engineer can now sense a wonderful unfoldment for the future in contemplating the enormous possibilities of regenerative application.

Regenerative application in its simplest analysis is the science or art of regenerating electrical energy where otherwise this energy would be dissipated in the form of heat and find no useful purpose. As applied to the railroad the momentum of the cars on down grades is made use of to pump energy back into the transmission system. This not only saves energies that would be otherwise dissipated but a new and ideally perfect system of braking is brought about. In saving of shoes alone for the brakes as ordinarily used an item of gigantic economy is brought about. Travellers who have passed over this road during the past season are enthusiastic over its unqualified success. So much so that the railway officials have recently announced a vast extension of this service to other portions of their system.

Looking about us it is not easy to see in the near future untold extensions of regenerative application that will broaden the present consumption of electricity by leaps and bounds although upon first analysis the reverse might be thought to be true.

Take the case of the automobile. At present operated by gas no possibility is offered for saving that great percentage of waste that is taken up in braking. However, by application to electric vehicles the regenerative principle will undoubtedly prove so saving and economical in the near future as to make this kind of propulsion superior and more economic than its great rival—the gas-operated car.

In ocean-going vessels, the principle will also find untold application. The electric drive now so universally popular can be used to regenerate power and make a saving in operation and also a far more delicate control in backing up and going forward can be brought about.

The future is indeed bright for the great principle of regenerative application and engineers of the West, where a brilliant future awaits its installation on all sides, will follow its evolution with the keenest interest.

PERSONALS

Guy C. Bailey, an electrical engineer of San Francisco, is installing a power plant in the Yosemite.

A. G. Wishon, general manager of the San Joaquin Light & Power Company, was a recent business visitor at San Francisco.

John A. Newland, purchasing agent for the San Joaquin Light & Power Company, was at San Francisco a few days last week.

L. W. Hunt, sales manager for the Commercial Electric Supply Company of St. Louis is a recent visitor on the Pacific Coast.

V. L. Crawford, general representative of Hubbard & Company of St. Louis has been a recent visitor in San Francisco and other coast cities.

D. E. Harris, vice-president of the Pacific States Electric Company, recently returned to San Francisco from a short business trip to Los Angeles.

J. B. Estabrook, secretary and sales manager of the Peerless Electric Company, Warren, Ohio, is a recent business visitor at San Francisco.

F. W. Slater of the turbine department of the General Electric Company of Schenectady, recently left for Los Angeles, on his return trip East.

E. Simon, radio expert, of New York, was a recent visitor at Los Angeles, where he was testing out his own apparatus on the government aeroplanes.

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, has returned to San Francisco after a six weeks' visit in Arizona and New Mexico.

Dr. L. W. Austin, government radio inspector, recently arrived in San Francisco, after inspecting the Chollis Heights Radio Station, San Diego, on behalf of the U. S. Navy.

C. R. Hunt, branch manager of Robbins & Myers Company of San Francisco, recently returned from an extended business trip throughout the southern part of the state.

J. W. Foster, chief alternating current engineer of the General Electric Company, of Schenectady, in company with Mrs. Foster, recently left San Francisco for the Northwest on his return East.

Waldo C. Cole, of the promotion department of the Westinghouse Electric & Mfg. Co., recently returned to San Francisco after an extended trip through the San Joaquin Valley in behalf of that department.

Dr. Morton G. Lloyd, formerly technical editor of the Electrical Review and Western Electrician, has accepted a temporary appointment as associate engineer in the Bureau of Standards, Washington, D. C.

O. Fujinami, electrical engineer of the Nagoya Electric Light Company, of Nagoya, Japan, is a recent arrival in San Francisco, where he will start on a tour of the United States to study the American electrical development.

Wm. Mulholland, chief engineer of the Los Angeles aqueduct, was a recent visitor at San Francisco, where he testified before the railroad commission, in behalf of the Peoples Water Company's rates in Oakland, California.

W. D'A. Ryan, lighting expert of the General Electric Company, who has been located for the past few months at Los Angeles, where he has been designing a street lighting system which is expected to be installed in the next few months, was a recent visitor at San Francisco.

H. C. Vensano has resigned as civil and hydraulic engineer of the Pacific Gas & Electric Company to form an association of contracting engineers with John R. and Edward G. Cahill under the firm name of the Cahill-Vensano Company with headquarters at 460 Montgomery street, San Francisco.

Rudolph Strauch, of the Pacific Gas & Electric Company, and **Fred Baker**, new business manager of the Sierra & San Francisco Power Company, who are a sub-committee of the Range Committee of the N. E. L. A., recently held a meeting at the offices of the Westinghouse Company at San Francisco.

B. E. Topiis, engineer of the British Westinghouse Company of Manchester, England, recently returned to San Francisco, after studying the conditions in the oil fields of California, and will start for the British East Indies, where he will superintend the installation of the electrical machinery in the oil fields at Burma.

J. E. Davidson, vice-president and general manager of the Pacific Power & Light Company, has resigned to accept a position with the Electric Bond & Share Company of New York. His first detail will be at Omaha where he will be connected with the Amaha Electric Light & Power Company. **John A. Laing**, who has been acting as general attorney for the company and **Lewis A. McArthur**, assistant general manager will be the new vice-president and general manager, respectively.

J. C. Holbrecht, an electrical contractor of Sacramento; **J. A. Crandson**, Portland manager of the General Electric Company; **E. C. Stoner**, manager of the Julien Electric Company of Atascadero; **Geo. Sanford**, manager of the Great Western Power Company of Rio Vista; **W. A. Ough**, manager of the Plumas Light & Power Company of Greenville, Plumas County; **J. C. Thirlwall** of the railroad department of the General Electric Company of Schenectady; **A. F. Dickerson**, lighting expert of the General Electric Company, with W. D'A. Ryan of Los Angeles; and **A. F. Flannagan**, proprietor of the Engineering Electrical Supply Company at Stockton were recent business visitors at San Francisco.

BOOK REVIEW.

Principles of the Telephone—Part 1, Subscriber's Apparatus. By Cyril M. Tansky, B. S., B. A., and Daniel C. Faber, E. E. Size 6 by 9 in; 160 pp.; 125 illustrations; cloth binding. Published by McGraw-Hill Book Company, Inc., of New York City, and for sale at the Technical Book Shop, San Francisco. Price $1.50.

This book is the first of a series that is being prepared in the extension division of the University of Wisconsin, in which university the authors are connected with the electrical engineering faculty.

The text has been designed to be of practical use to men who are actively engaged in the installation, care, and operation of telephone apparatus. Although details of construction are not given to any extent, the authors set forth clearly the principles that underlie good construction. The treatment covers such subjects as elementary electrical principles, magnetic principles and sound. It then proceeds to discuss transmitters, receivers, induction coils and signalling apparatus with discussions of the subscriber's telephone set. The chapters relating to faults in substation, protection of telephone lines and apparatus and their installation are especially helpful. A series of questions is appended at the end of each chapter that assist the beginner in fixing the points brought out in the text. The book should find a welcome reception among men desiring a clear practical treatment of the subject matter involved.

MEETING NOTICES FOR ELECTRICAL MEN

(The continual getting together of engineers of the West is having a marked effect in not only cementing friendships but in immeasurably heightening the usefulness of the engineer and his profession. In the following lines are recorded meetings of interest to electrical men that have taken place in the past two week period in various localities of the West.—The Editor.)

San Francisco Electrical Development and Jovian League

Grayson Harrison of the Fireman's Fund Insurance Company, San Francisco, was the speaker of the day at the February 14th meeting of the League. Mr. Harrison was introduced by D. E. Harris, who acted as chairman of the day. The speaker gave an interesting talk on the history of insurance, and the growth and development of the great insurance firm of Lloyds of England. President Newbert appointed Messrs. E. M. Cutting, R. F. Behan, P. Decker, A. Meinema and J. C. Manchester as a nominating committee to present a list of candidates at the next business meeting for the various offices of the league to serve for the new term.

The meeting of February 21st was devoted to an interesting paper given by Roy Bishop on the modern traffic problems of railroading. Mr. Holland of the Great Western Power Company acted as chairman of the day.

Bi-Weekly Luncheon of the Joint Local Sections of the A.I.E.E. and N.E.L.A. with the Oregon Society of Engineers.

This meeting was held in the orange room of the Oregon Hotel, Wednesday noon, February 14th.

The chairman of the day was A. S. Moody and the program was turned into a farewell luncheon to J. E. Davidson, past chairman of the Portland Section, N. E. L. A., who is leaving Portland to accept an executive position with the Electric Bond & Share Company of New York.

J. A. Laing, the new vice-president of the Pacific Power & Light Company, gave a short talk on Mr. Davidson's record. A. S. Griener, vice-president of the American Power & Light Company, New York, Dr. F. W. Vincent, local manager Portland Power & Light Company, Pendleton, Oregon, and B. P. Bailey, local manager Portland Power & Light Company, The Dalles, Oregon, were also guests of honor at this luncheon. The attendance was seventy-three.

Lewis A. McArthur, the New General Manager of Pacific Power & Light Company

Portland Sections of N. E. L. A. and A. I. E. E.

The regular joint meeting of the local sections of the A. I. E. E. and the N. E. L. A. was held in the Assembly Hall of the Multnomah Hotel, Tuesday evening, February 6th. The chairman of the evening was J. C. Hinkle. The speaker was Prof. W. C. Morgan of Reed College on "The New Chemical Element—Electricity." This talk was illustrated by lantern slides. Prof. Morgan said in part: "At present the great scientists are debating the question of the 'constitution of an atom,' and many of the old theories are completely upset, but as yet the new ones are so vague that no one understands them." The attendance was seventy-two.

Oregon Society of Engineers

The annual banquet and election of officers of the Oregon Society of Engineers took place at the University Club, Monday at 6:30 p. m., Feb. 5, 1917, many scientific and technical men attending. The new officers who will manage the affairs of the organization for the ensuing year are as follows: H. L. Vorse, president; J. P. Newell, vice-president; Orrin E. Stanley, secretary; Henry M. Morse, treasurer; J. W. Cunningham, L. F. Harza and O. Laurgaard, directors; R. E. Cushman, R. G. Dieck, R. J. Grace, W. P. Hardesty, H. B. Hastings, C. P. Keyser, H. E. Plummer and Harold A. Rands, nominating committee.

The secretary reported that there had been obtained 56 new members during the year and that there was $1028.70 on hand in the bank.

Prof. Frank Laxley Griffin of Reed College discussed Prof. Otto B. Goldman's article, published in the Journal of the Oregon Society of Engineers, Vol. 3, on "The Engineer and Mathematics." Prof. F. L. Griffin said that he heartily endorsed everything in the paper and that he was endeavoring in his own work to carry out some of the methods suggested by Prof. Goldman.

Other discussions of the evening were as follows: J. P. Newell discussed House Bill 213, relating to the state road work. Dr. W. F. Amos discussed "Vaccination." Prof. Otto B. Goldman discussed and severely criticized Clyde B. Aitchison's "Cost of Service Analysis in Public Utility Rate Cases," published in Vol. I of the Journal of the Oregon Society of Engineers.

Prof. Goldman contended that this article is absolutely inconsistent in its arguments and will not bear a close analysis. He again referred to his paper on "The Multiple Rate and Cost System," first published in the Journal of Electricity, and again published in the 1915 Transactions of the A. I. E. E., and stated that now, after two years, no one had endeavored to criticize it. Messrs. Rockwood, Thompson and Colby also entered into the discussion. Seventy members were in attendance.

TRADE NOTES

Hampton Electric Company, formerly at 502 Mission street, recently moved to larger quarters located at 518-22 Mission street, under the name of Hampton Electric & Machinery Company.

Combining effectiveness of selling features with simplicity of design, the display window of the Bristol (Tenn.-Va.) Gas & Electric Company took first prize in the National Mazda

window contest conducted during November and December. The Doherty Company triumphed over 1886 competitors. The display was the idea of W. B. McSpadden, new business representative.

In order to definitely handle the large amount of raw material necessary in the manufacture and production of "Century" apparatus, the Century Electric Company of St. Louis, Mo., has let a contract for the erection of a reinforced concrete warehouse containing some 15,000 square feet of floor space with terminal facilities and designed with special reference to handling sheet steel, shaft stock and other raw material. The warehouse when completed will be equipped with all of the up-to-date appliances for handling heavy material, such as jib and traveling cranes.

The following changes and additions to the organization of the Century Electric Company have recently been made: G. Y. Watt, formerly in charge of the Rochester office of the Century Electric Company, has now been transferred to the new sales office opened at 10 High street, Boston, Mass. He will be assisted by J. F. Elliott and H. P. Westervelt. G. H. Lindsey, formerly connected with the St. Louis Office, has been placed in charge of the Rochester Sales Office, 525 Granite Building. The sales organization at St. Louis has been increased by the addition of Mr. E. S. Moore, who will have charge of the Fan Department.

M. G. Jeffress, formerly a practicing attorney of San Francisco, recently purchased the entire interest in W. T. Garratt & Co., the bell and brass foundry, machine shop and hydraulic works, and has given up his law practice to take up the active management of the company. W. T. Garratt & Co. has a record of sixty-six years of continuous business, having been established in 1850. As a bell foundry it has held for many years a very prominent position throughout the western half of the United States. The company is also widely known as the manufacturer and owner of the Hooker Pump, and also as the manufacturer of the Garratt Jack Head Pump and the Garratt Deep Well Pump. The two former pumps are used extensively throughout the various mining districts of the West for sinking purposes.

Utility Activity at Stockton

The board of directors of the Western States Gas & Electric Company has declared the regular quarterly dividend of 1¾ per cent on the preferred capital stock of the company, payable January 15 to stockholders of record December 30th.

New business is being connected by the various divisions in steadily increasing ratio. At Stockton the Holt Manufacturing Company has completed an additional machine shop which will be electrically operated. The Western States Gas & Electric Company supplies the electrical requirements of this concern amounting at the present time to 750 h.p. The new machine shop will require in the neighborhood of 250 h.p. additional. A contract has been closed by the company with the Samson Sieve-Grip Tractor Company for 200 h.p. in motors in addition to the 241 h.p. now being furnished. The Samson company is doubling its output, the plant being operated day and night.

TRADE OPPORTUNITIES IN PACIFIC LANDS.

Details concerning the foreign trade opportunities listed below may be obtained by addressing the United States Department of Commerce at Washington, D. C.:

A man in Colombia wishes to get in communication with manufacturers of machinery for making mosaic and floor tile.

A firm in Chile wishes to secure an agency for the sale of motor-truck chassis, with a four-wheel drive. Quotations should be made f. o. b. New York. Cash will be paid. Correspondence may be in English. References.

A man in Chile is in the market for a universal milling machine, suitable for making all kinds of automobile gears and capable of doing a great variety of other work. Correspondence should be in Spanish. Reference.

A man in Brazil desires to receive prices from American manufacturers and exporters of general merchandise, hardware novelties paper, etc. He has submitted a complete list of articles wanted, a copy of which may be obtained from the Bureau or its District Offices.

The representative of a firm which does business in Argentine, Paraguay, and Uruguay has opened an office in New York and desires to secure agencies from American manufacturers and exporters of cotton piece goods, such as drills, printed shirtings, tickings, etc. References.

A firm in Chile is in the market for printing and lithographing inks for stock and sale. Quotations should be made c. i. f. destination. References. Correspondence preferred in Spanish, but may be in English.

NEW BULLETINS

The analytical distillation of petroleum is the subject matter of Bulletin 125, just published by the United States Bureau of Mines.

Pass & Seymour, Inc., of New York City, has just issued catalog Number 24 for 1916-1917, entitled Handy Electric Wiring Devices which should prove of much practical value to the contractor and dealer.

The tractive resistance on curves of a twenty-eight ton electric car is discussed by Edward C. Schmidt and Harold H. Dunn in bulletin 92 of the Engineering Experiment Station of the University of Illinois.

Technical paper 118 of the Bureau of Mines, just issued, is a thirty-six page pamphlet on the very important discussion of suggested safety rules for installing and using electrical equipment in bituminous coal mines.

The uses of open heaters in connection with the heating, metering and softening of water for boiler and other purposes are exhaustively treated in a 100-page book (Publication No. 710) lately issued by the Harrison Safety Boiler Works, Philadelphia, Pa.

Bulletin No. 3 of the State Highway Commission of Oregon has recently been issued. The bulletin is in the nature of a bridge manual and contains standards, general information and instructions regarding highway construction that are of much value to highway engineers.

Three four-page envelope enclosures have just been published by the Cutler-Hammer Manufacturing Company of Milwaukee, describing C-H electric laundry irons, C-H electric tailors' irons and C-H electric soldering irons respectively. The folder concerning laundry irons lists irons of two weights most convenient for domestic use.

Bulletin 74 of the Bureau of Standards deals with an investigation of cartridge-inclosed fuses. In substance it is a report of the Bureau of Standards in the case of Economy Fuse & Manufacturing Company vs. Underwriters' Laboratories (Inc.), concerning the fire and accident hazard of the Economy refillable fuse as compared with approved fuses.

The tractive resistance on curves of a 28-ton electric car has been made the subject of a study by the railway department of the Engineering Experiment Station of the University of Illinois. The results which are set forth in Bulletin No. 92 of the station establish, for this car, the relation between curve resistance and speed, and between curve resistance and rate of curvature; the ratio in both cases is direct.

An unusually artistic and striking piece of publicity has just been issued by the Westinghouse Electric & Manufacturing Company, entitled "Get This Crowd Headed Your Way With——" and "Westinghouse—the Value of the Name." The latter publication is 12 by 14 in. and contains a number of striking pages of beautifully illustrated matter on electrical appliances in the home, recently featured in the magazines of America.

LATEST IN EVERYTHING ELECTRICAL

(Industrial activity in affairs electrical are recorded from several distinct fields of activity in the following pages. A new power factor meter, the announcement of gigantic enlargement of the Westinghouse plant, window display prizes, electrical appliances on the Mexican border, together with descriptions of new electric stoves, coffee grinders, potentiometers and the like constitute the further items of interest set forth.—The Editor.)

A NEW WESTERN FIRM OF MANUFACTURERS' AGENTS

Garland-Affolter Engineering Company, 315 Rialto Building, San Francisco, representing as district managers the Moloney Electric Company for California, Nevada and Arizona, in the sale of transformers; the Peerless Electric Company for the territory west of Salt Lake City and Helena,

P. H. Affolter

A. E. Garland

Montana, in the sale of single-phase motors and other electric apparatus manufactured by them; the Howell Electric Motors Company, the same territory for the sale of polyphase motors; this firm also will represent on the coast the Allen-Bradley Company and the Union Electric Manufacturing Company, manufacturers of motor control apparatus and automobile charging switchboards.

P. H. Affolter has been for the past six years manager of the electrical department of the San Francisco office of Fairbanks, Morse & Company, having previously been designing engineer for the Western Electric Company, at their Hawthorne Works at Chicago.

A. E. Garland has also been with Fairbanks, Morse & Company for the past ten years, the last five of which were spent among their various branches as traveling electrical engineer. Previous to this he was engaged for a number of years in the manufacturing of electrical apparatus.

The Journal extends its congratulations to the manufacturers represented by this new Western firm, and its best wishes to the Garland-Affolter Engineering Company.

NEW WESTINGHOUSE PLANT

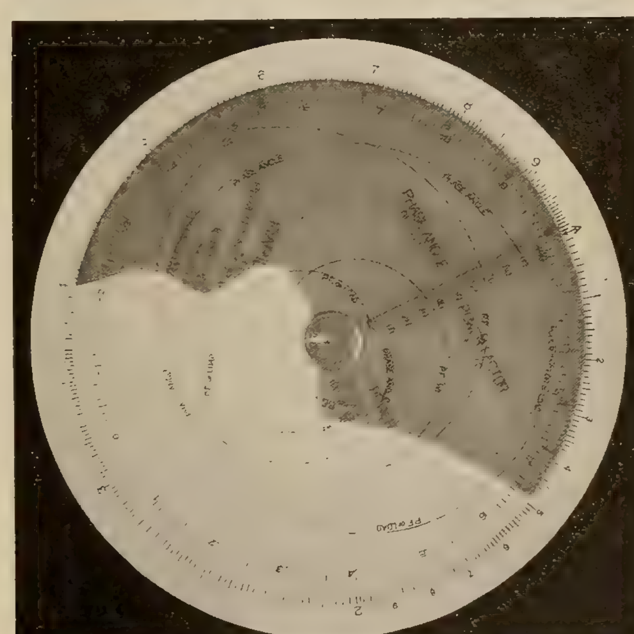
Announcement has just been made by the Westinghouse Electric & Manufacturing Company that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial center for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately one mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia and Reading Railroads.

This new center will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers and reduction gears. The initial development will cost in the neighborhood of $5,000,000 or $6,000,000 occupying about one-fifth of the area of the entire plot. The group will consist of the following buildindgs: two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let.

The number of employes to be engaged at the new plant has not as yet been definitely determined but will number several thousand people, and undoubtedly will in the future equal the number employed at East Pitsburgh, representing over 20,000 people.

A NEW POWER FACTOR METER

Messrs. Hoag & Backstrand of Riverside, California, have recently perfected a new power factor meter. A circular plot shown in the background has superimposed upon it a celluloid



A New Power Factor Meter

scale shown in section in the illustration. By revolving the celluloid scale in front the power factor is at once ascertained from the curves ploted upon the background. The meter is sold for a dollar, and may be purchased by addressing the Technical Book Shop, San Francisco.

NEW BULLETINS

Pass & Seymour, Inc., of Salvay, N. Y., has just issued form 1105 on P. & S. chain pull candle-fixture sockets.

Bulletin 162 of the Electric Storage Battery Company discusses the progress made in their buildings since June 1916.

Experimental researches on skin effect in steel rails are set forth in bulletin 12 by A. E. Kennelly and others of the research division of the electrical engineering department at the Massachusetts Institute of Technology.

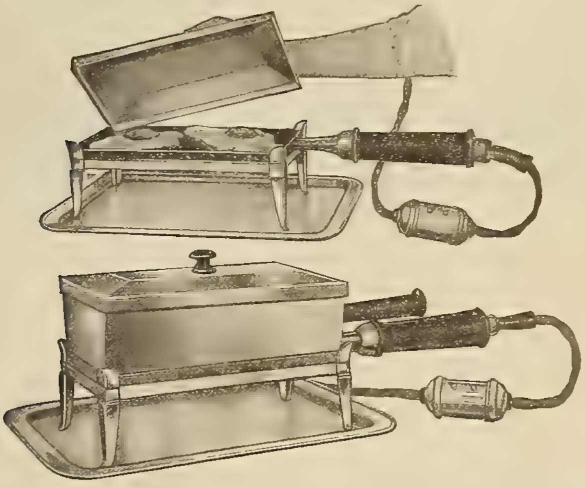
ELECTRICAL APPLIANCES FOR OUR SOLDIERS.

Down on the border line of Mexico the boys are making use of the latest appliances of electrical design to lessen the drudgery of work. Here is an illustration of a day in camp that softens the hue of the sky when "blue Monday" comes around.

Doing It Electrically on the Border

NEW TABLE STOVES

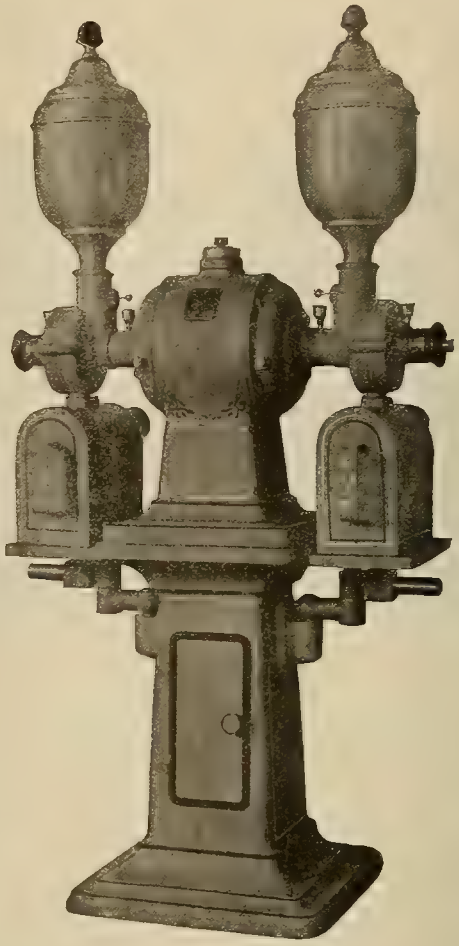
The new C-H Electric Combination Table Stove made by the Cutler-Hammer Mfg. Co. of Milwaukee has been tested and put upon the market. With this versatile little appliance you can sit at the table and cook an entire meal with the current from an ordinary lamp socket. In one small oblong stand, on four slim little legs, you have a frying pan, griddle, toaster, broiler, saucepan and small oven.


The New Electric Table Stove

The heater is made of two sheet steel plates which are welded together and inclose the heating elements. This can be placed above or below the cooking vessels, according to the type of cooking demanded.

COLES ELECTRIC COFFEE MILLS

The coffee mills and the combination mill and meat grinder shown are new models that have been placed on the market by the Coles Manufacturing Company of Philadelphia, Pa. The small mill will granulate a pound of coffee in forty seconds and can be connected to the ordinary electric light socket. It is operated by a ¼ h.p. Westinghouse motor. This mill has obstruction release to clear grinders; an indicating regulator which provides for six grades of coffee; a detachable hand crank for hand operation of the mill should current fail, and a self-cleaner and dust-proof pan. It occupies a counter space of 12 by 17 inches, and is 27 inches high.


Combination Coffee Mill and Meat Grinder

The double mill will granulate five pounds of coffee per minute or pulverize one pound per minute. It is operated by a ¾ h.p. Westinghouse motor. The motor operates both grinders at the same time. This mill has an automatic releasing and resetting device, self-cleaning heads, dustproof pans, indicating regulator which provides for twenty grades of coffee, and six pound nickel hoppers. It is furnished for mounting on the counter or with pedestal base for floor mounting.

The combination coffee mill and meat chopper has a capacity of 8 pounds of beef per minute, or will granulate two pounds of coffee per minute. It is operated by a ¾ h.p. Westinghouse motor. All parts, including the bowl are removable. The regular equipment consists of four sets of knives and plates, one sausage stuffing attachment, meat pusher, spanner wrench for chopper ring. Bone grinder, pulley, or tool grinder also furnished when desired. It is furnished for mounting on the counter or with pedestal base for floor mounting. It occupies a counter space 20 by 32 inches and is 36 inches high.

Such appliances and labor saving devices as these are immeasurably increasing the efficiency of modern routine work in the trades.

$1250 CONTEST FOR WIRING CONTRACT SOLICITORS

Cash prizes aggregating $1250 to be awarded by the Society for Electrical Development in annual "Wire Your Home Time" campaign, April 1st to May 15th. Committee meets and decides on plans for spring housewiring drive.

The Society for Electrical Development has announced a $1250 cash prize campaign to salesmen in connection with its annual spring housewiring drive, April 1st to May 15th.

The contest is open to all housewiring contract solicitors employed by central stations or contractors who are members of the society.

The country will be divided for campaign purposes according to population so that cities and towns of nearly equal size will have equitable chance of competition. Under the plan as arranged the prize money will be divided equally between five classes:

1. Cities of 15,000 or under.
2. Cities of between 15,000 and 50,000.
3. Cities between 50,000 and 100,000.
4. Cities of between 100,000 and 500,000.
5. Cities of 500,000 and over.

POTENTIOMETER FOR "HOT SPOT" TEMPERATURE MEASUREMENT.

The importance of knowing the temperature of the hottest part in electrical machines is now well recognized. The most accurate and reliable method of measuring temperature in parts of machines inaccessible to thermometers, is by means of a thermo-electric couple. The practice of building

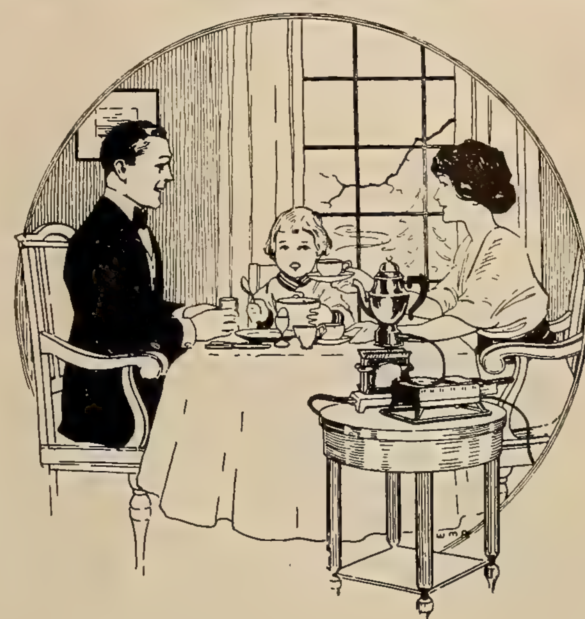
Improved Potentiometer for "Hot Point" Temperature Measurement

such couples into the windings of large machines at points where the highest temperatures are reached, though of comparatively recent origin, is fast becoming standard. The thermo-electric couple is found to be more reliable than copper wire pyrometer or search coils sometimes employed, for the reason that the necessarily delicate construction and insulation of such coils render them liable to undetected damage during construction, or destruction of the insulation due to service conditions.

For measuring the temperature at a point where a thermo-electric couple has been installed a potentiometer is utilized. This instrument balances the electromotive force of the couple under test against that of another couple at known temperature. This avoids all errors due to variation in leads, etc., and as all indications are on the "Null" or zero reading principle, very accurate readings are obtained. The reading is given directly in degrees, Centigrade. By using a dial switch, any number of thermocouples on one machine or on several, can be read at will with one potentiometer at any desired location.

SUGGESTIVE HINTS FOR DEALERS

Here is the latest thing electrical in the way of suggestions to aid dealers in increasing electrical appliance



This is for Men Folks!

To you, Mr. Man, who are in the habit of eating your breakfast alone, while your wife is running back and forth to the kitchen—picture this little scene:

sales. This is a suggestion sent out by the Society of Electrical Development to assist sales service in electrical appliances.

CONTESTS OF NATIONAL LAMP WORKS

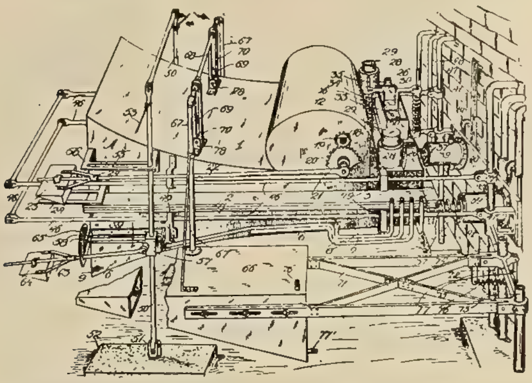
The National Lamp Works of Cleveland has awarded the first prize, a Ford Touring Car, for its annual window display contest to W. R. McApodden of the Bristol Gas & Electric Company, Bristol, Tenn. The simplicity, yet effective manner in which the display is brought out is wonderfully apparent in the illustration shown herewith.

The First Prize Setting for the National Lamp Works Contest

WHAT WESTERN INVENTORS ARE DOING

(Great practical application throughout the West could be put to efficient creation for making use of wave-force and low heads of running water. Two inventions are herein recorded looking toward the utilization of these latent energies. Electric cooking and wireless telegraphy also come in for description, due to recent activity of Western inventors along these lines.—The Editor.)

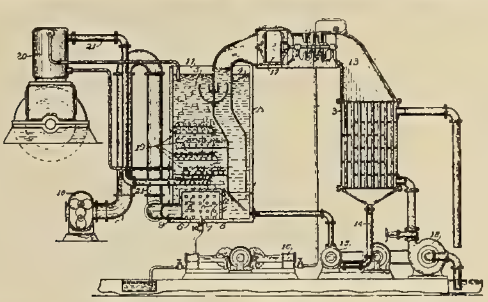
1,214,257. **Wave-Force Utilizing Device.** Emmer B. Arnold, Los Angeles, Cal.



A device for utilizing the force of waves, comprising an inclosure having a water cushioning chamber, and a plurality of outlets beyond said chamber.

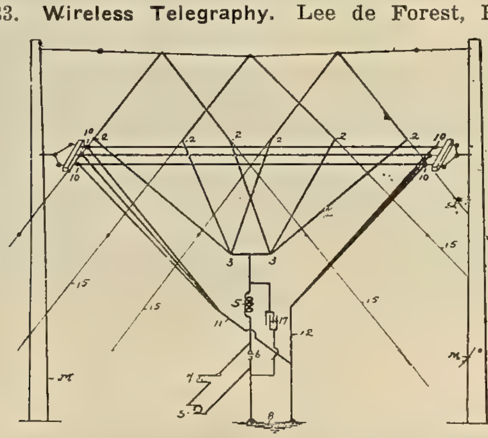
1,214,103. **Power-Generating Apparatus.** Fred L. Williams, San Francisco, Cal.

A power-generating apparatus comprising an open-ended boiler adapted to contain water, means for passing a heating medium through the boiler and out the open end thereof



for heating water, a steam-operated, power-generating unit, and a pipe connected with the inlet side of the unit, said and a pipe connected with the inlet side of the unit, sai pipe having its opposite end submerged in the water contained in the boiler.

1,214,283. **Wireless Telegraphy.** Lee de Forest, Palo Alto,

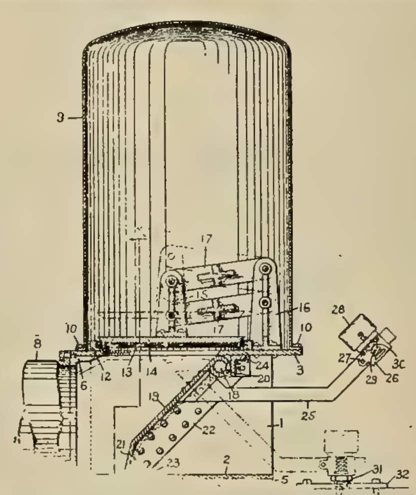


Cal., assignor to Federal Telegraph Company, a corporation, of California.

A transmission system for wireless communication, an elevated fan-shaped main antenna, a conductor connecting said antenna to earth, an inductance and a source of electrical oscillations in said conductor, a supplementary horizontal antenna arranged within and insulated from said main antenna and a conductor connecting said supplementary antenna to earth.

1,214,192. **Hydraulic Ram.** John E. Lester, Tacoma, Wash.

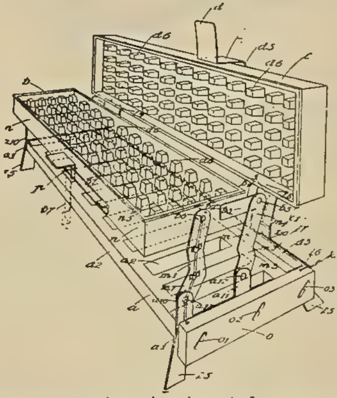
A hydraulic ram, a supply pipe, a casing connected therewith and having a direct horizontal passage alined with the supply pipe, a waste-valve pivotally mounted in the casing and swingable from an open position substantially parallel with the horizontal passage to a closed position extending angularly across said passage, a delivery-valve controlling a lat-



eral outlet from the horizontal passage adjacent to that edge of the waste-valve which is farthest from the supply pipe, and means connected with the waste-valve and tending to swing the same toward the open position thereof.

1,214,486. **Electric Cooking Apparatus.** William D. Wright, San Diego, Cal.

A device of the kind described, a grill member mounted



at each end on a support, a horizontal support parallel to the grill member mounted at each end of one of the supports, a plurality of swinging arms each mounted at one end on extended portions of the first named supports, a waffle member pivotally mounted on the other ends.

NEW ELECTRICAL DEVELOPMENTS

(The greatest new development of the past two week period in the West seems to be along the line of increased activity in conserving water for storage. This water is to be used both for hydroelectric and domestic supply purposes. Instances of these dams under way are to be found in the front pages of this issue. In the following items are noted many new electrical developments now in progress in various sections of the West.—The Editor.)

FINANCIAL

SAN FRANCISCO, CAL.—American telephone companies had a total revenue of $24,976,258 for October last, an increase of nearly 14 per cent over the previous, according to statistics made public by the I. C. C. Net operating income for the month was $6,920,199, nearly 30 per cent of the total revenue. The total number of telephones operated by the reporting companies was 7,080,314, an increase of 609,817, or about 1 0per cent over 1915. While operating revenues increased about 14 per cent, expenses increased approximately 15½ per cent. For the tenth month ending with October returns to the commission show that the companies received total revenues of $234,377,047, an increase of nearly 12 per cent over the previous year, of which $65,823,632 was net operating income.

ILLUMINATION

SANTA BARBARA, CAL.—The F. E. Newberry Company of Los Angeles was awarded the contracts for ornamental light installation in both districts on State street.

SONORA, CAL.—An election will be called soon to pass on the proposition for establishing an underground municipal lighting system. The system is estimated to cost about $20,000.

MARYSVILLE, CAL.—The Meridian Ladies' Embroidery Club is circulating a petition which will be submitted to the board of supervisors at the next meeting. The petition asks the supervisors to call an election for the installation of a lighting system for the town of Meridian.

SALINAS, CAL.—The electrolier committee of the Chamber of Commerce and City Council agreed to turn the matter over to lighting expert C. F. Phillips. At a meeting of the council Mr. Phillips will be authorized to go ahead with estimates relating to the installation of electrolier system.

SAWTELLE, CAL.—Application has been made by the Beverly Hills Utilities Company to the board of trustees of the city of Beverly Hills for a franchise granting a right for a period of 40 years to construct and operate a system of pipe lines in certain public streets, for the purpose of supplying gas. Sealed bids will be received at the office of the city clerk.

LOMPOC, CAL.—That the Continental Securities Company, holders of the controlling interest in the Lompoc Light & Power Company are again negotiating for the sale of the local light plant to the Midland Counties Public Service Corporation has become known. According to officials of the Midland Company no purchase will result, as the owners of the local plant are holding out for too high a figure.

TRANSMISSION

RITZVILLE, WASH.—William H. Galvani, a civil engineer of Portland, connected with the Pacific Power & Light Company, has been negotiating with the county commissioners relative to a right of way for power lines in Adams County.

QUINCY, CAL.—The Indian Valley Railroad Company has sold to the Great Western Power Company its right of way for the construction of an electric transmission line along the railroad right of way between Paxton Station and Engel's Copper Mine.

YREKA, CAL.—The California-Oregon Power Company has closed a contract to extend a power line to the Konrad Holfelder ranch south of Montague for a pumping plant of Hudson & Edmonds. These men intend to irrigate a large area of land in that vicinity.

LOS ANGELES, CAL.—For right-of-way for its power transmission line through the Ivanhoe district, the city will be required to pay an aggregate of $6175. This is the last link in the 45 miles of right-of-way the city will require in its power project, connecting power plant in San Francisquito canyon with the central substation in East Los Angeles.

SAN BERNARDINO, CAL.—For the purpose of launching a campaign to secure a municipal light and power plant, or at least a distributing system for light and power here, a public meeting has been called. It is predicted that a municipally owned plant for light and power will be one of the big issues of the coming spring election.

BOISE, IDAHO.—The appropriations committee of the house of representatives may visit the Gem irrigation district soon for the purpose of investigating the merits of the bill introduced providing for an appropriation of $3000 for a power plant to generate electricity for the pumping of water to lands within the project.

SALEM, ORE.—The Portland Railway, Light & Power Company has recently commenced the construction of a new 60,000-volt electric power transmission line to Salem from what is known as their River Mill hydroelectric plant, near Estacada. This line will supply power to Salem and to the substation at Mill and Liberty streets. The expense involved in bringing this new line into Salem will be about $40,000.

BEND, ORE.—Kempster B. Miller stated that improvements would be made next winter to the Bend Water, Light & Power Company plant, which will cost between $50,000 and $75,000. An addition will be built to the power unit, and the balance of the work will go on the water and electrical distribution systems extensions. Mr. Miller is engineer for the company.

TACOMA, WASH.—Steps are being taken for the construction of additional facilities for increasing the capacity of the municipal power plant and a new auxiliary steam plant to cost $300,000 instead of a new hydroelectric plant to cost $3,000,000. Commissioner of Light and Water Gronen and City Attorney Harmon are now drafting a resolution which will bring the proposition before the taxpayers. An engineer will be appointed at once to make an investigation.

PARKER, ARIZ.—Within the next few months it is probable that the Southern Sierras Company of California will have its transmission lines into Parker, furnishing electrical power for irrigation, lighting and mining. H. N. Seifried, representing the company, has been here seekng data on prospective business for electric power. The company is now building into Yuma and it plans upon putting a transmission line into the Quartzsite country. Another line is being constructed to Barstow. It is probable that the Barstow line may be extended to Parker, and a line run from Blythe Junction to Blythe and Quartzsite.

TRANSPORTATION

HONOLULU, T. H.—Plans for the extension of the track system of the Honolulu Rapid Transit & Land Company will soon be started.

FULLERTON, CAL.—The Board of Trustees has granted the Pacific Electric Company a franchise into Fullerton. To reach Fullerton the company has merely to build from La Habra, a distance of about four miles.

SAN FRANCISCO, CAL.—The board of works is receiving bids for 34,500 pounds of copper trolley wire in two sizes, or a total length of about ten miles, and worth in the neighborhood of $14,000.

WHITTIER, CAL.—Whittier is interested in the development work of the Pacific Electric Railway, and at present a special committee of the Chamber of Commerce is working on the project of the extension of the line through this city. One conference with heads of the company has already been held and some encouragement has been received. It has been understood that the Pacific Electric would build to Riverside and Corona from the Yorba Linda terminal, but recent reports are to the effect that the Corona territory will be reached by a branch line from Pomona.

TELEPHONE

NEWMAN, CAL.—The Pacific Telephone & Telegraph Company has filed with the trustees an application for a franchise. Bids are being received by the city officials.

FRESNO, CAL.—The board of trustees of the Laguna Reclamation District No. 779 announce that the telephone lines owned by the district, extending west and south from Laton a distance of about 11 miles, with equipment, will be sold at public auction on March 8th.

SAN DIEGO, CAL.—Fire has badly damaged the El Cajon branch of the Home Telephone Company and the office is now in operation under a tent. The roof was burned off the building. The switchboard and rack are still on the original floor, with the tent over them in place of the burned roof.

DOUGLAS, ARIZ.—The second leg of the Tucson to El Paso circuit of the Mountain States Telephone & Telegraph Company is nearing completion. When completed the entire circuit, composed of two No. 8 copper wires, will have cost about $145,000. Work on a branch line from Bisbee and Tucson is being pushed rapidly.

KINGMAN, ARIZ.—The Arizona, California & Nevada Telephone Company may shortly link the Weaver district with Kingman by telephone if a report made by the manager of the company's office at Chloride is looked upon favorably by the company. The project wil require the construction of about eight miles of line at an approximate cost of $350.

HANFORD, CAL.—At a meeting held with J. A. Whan, manager of a local exchange for the Pacific Telegraph & Telephone Company, a committee of residents of Delta View district agreed upon plans for the installation of a new telephone line into that part of the country. A company will be organized and a telephone line constructed and operated.

ORANGE, CAL.—The board of trustees is receiving bids for one four-line loop storage battery switchboard, consisting of one manual four-line loop storage battery switchboard enclosed in an oak frame, with necessary storage batteries to operate the fire alarm system; one storage battery rack with necessary glass strips and porcelain insulators and one motor generator set for charging batteries.

IRRIGATION

OLINDA, CAL.—The Happy Valley Irrigation District, which was suspended in 1895, is to be revived. The purpose of the reorganization is to acquire the water rights of the Happy Valley Water Company, purchase more water rights and extend the irrigable field in Happy Valley.

KOOTENAI, IDAHO.—A. H. Featherstone, proprietor of the Bonner Water & Light Company, was in the city looking over the plant and promised considerable improvement in the spring. A new pumping station of concrete will be among the improvements.

LOS ANGELES, CAL.—The East Side Land & Water Company of Los Angeles has applied to the state water commission for permission to appropriate 300 c.f. from Cowhead or Pelican Lake and 125 c.f. from Twelve-mile Creek, in Modoc County, for irrigation purposes.

MEDFORD, ORE.—W. J. Scott of Antioch has proposed the formation of a co-operative community district, to be bonded for the construction of an electric power plant and irrigation system. The district will include 25,000 acres of land in Sams Valley. The priject is estimated to cost about $1,000,000.

DIXON, CAL.—W. J. Wayland has applied to the state water commission to appropriate, for the proposed Dixon Irrigation District, in the vicinity of Dixon, 300,000 to 350,000 acre-feet per annum of the waters of Putah Creek, tributary to the Sacramento River, for the purpose of irrigating 55,000 acres of land.

FRESNO, CAL.—Landowners of Fresno County in mass meeting voted approval of the plans to construct a $9,000,000 reservoir at Pine Flat, Fresno County, to irrigate 1,000,000 acres in Fresno, Tulare and Kings Counties, and a committee will be named to ascertain if the Fresno Irrigation District desires to enter the project. Hydroelectric power for drainage will also be developed.

TURLOCK, CAL.—The board of directors of the Turlock Irrigation District, containing 176,210 acres, is now preparing an estimate of cost for the addition of 2700 more acres, located southwest of and adjoining the Turlock district. The work of draining certain portions of the Turlock Irrigation District is progressing favorably, except in the Tully tract, where quicksand has been encountered. The directors have authorized the purchase of a thousand eucalyptus trees, which will be set out along the various dams of the district as a matter of protection. Water for irrigation will be ready for turning into the canals by February 15th, if needed.

LINDSAY, CAL.—Word has been received here that the State Validating Commission, composed of the Attorney General, State Bank Examiner and State Engineer, had approved and validated the issuance of $1,400,000 bonds for the construction of the Lindsay-Strathmore Irrigation District. This is joyful news for the people of Lindsay as well as those who will come under the proposed project, and the work will now go forward with renewed haste. The contractors announce that they expect to complete the work by next June. The board of directors held a meeting in Los Angeles recently and the returning members confirmed the news of the validation. Approximately one-fourth of the project has already been completed.

SACRAMENTO, CAL.—A petition for the establishment of the Fair Oaks irrigation district under the provisions of the Wright act was presented to the county supervisors. George Bell, resident of the district and member of the water committee, and R. A. Rose, chairman of the water committee, were called as witnesses and testified to the needs of the district and the advantages of the proposed system. The proposed Fair Oaks district includes 3060 acres in Fair Oaks city, Fair Oaks addition, Fair Oaks Park and Fair Oaks tract. It is proposed to purchase water for the district from the North Fork Ditch Company, whose line delivers 28 c.f.p.s. or miners' inches, at the lower penstock reservoir which is ample for the district. The district will purchase and make use of, so far as possible, the pipe lines of the American Irrigation Company, which now is watering the section. A bond issue of $140,000 is proposed for financing the project.

Devoted to the Generation, Distribution and Utilization of Energy

JOURNAL OF ELECTRICITY

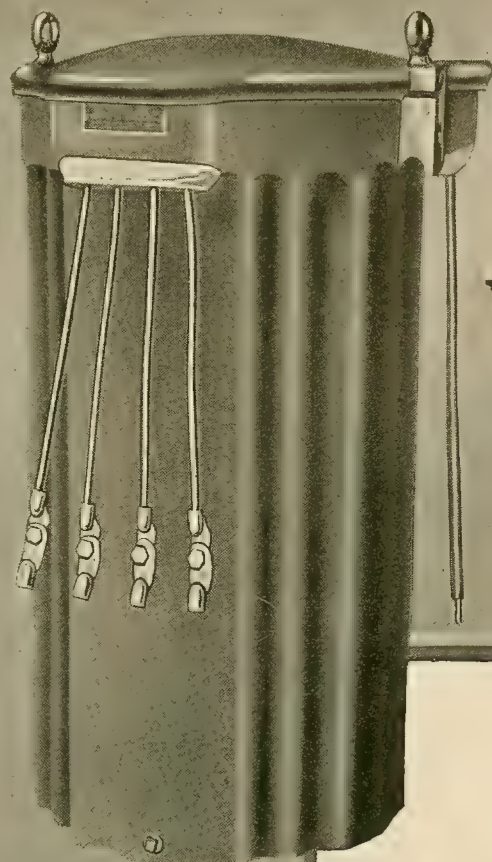
VOL. XXXVIII NO. 6 SAN FRANCISCO, MARCH 15, 1917 PER COPY, 25 CENTS

"SHOULD AULD ACQUAINTANCE BE FORGOT"

(Incidents in the Life of the Engineer of the West not found in the formal Record of his Work)

In This Issue—

Index to Advertisers, Page 8 *Where to Buy It in the West, Page 7* *Electrical Clearing House, Page 10*



Type "H"
Distribution Transformer

JOURNAL OF ELECTRICITY

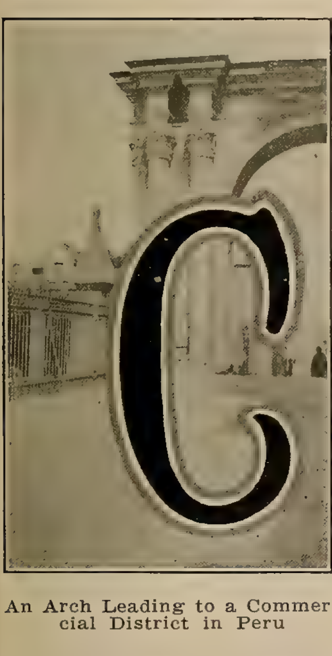
Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII SAN FRANCISCO, MARCH 15, 1917 NUMBER 6

THE PROGRESS OF AMERICA IN TRADE AND FINANCE

BY JOHN CLAUSEN

(The engineer of the West, due to easy communication by water to all countries bordering the great Pacific, must of necessity keep himself well versed in the progress of America in trade and finance. In order to strengthen commercial and engineering relations with these countries, familiarity with the recently evolved Federal system of letters of credit, bills of exchange, commercial acceptances, bankers' sight drafts and commercial sight exchanges is of utmost importance. Here is a timely discussion of these points by the manager of the foreign department of The Crocker National Bank of San Francisco. Coming as it does from this well-known Western banking house, this contribution should prove of unusual interest to engineers of the West.—The Editor.)



An Arch Leading to a Commercial District in Peru

CONDITIONS are now peculiarly set for our merchants to increase their business with foreign countries, and, while it is fully appreciated that much of the trade which the rest of the world transacts with us at present is being diverted under compulsion, it behooves us to take what steps we can to establish intimate and satisfactory relations with these new customers that will assure continued trading even after our European contemporaries again enter the field of competition.

In the field of foreign trade there will be many articles which we cannot supply in competition with Europe, while on the other hand, by reason of our natural resources, there will be much we can advantageously produce and so create a vast and favorable commerce.

The Need for an American Merchant Marine.—It is a well recognized fact that the American merchant has been at a disadvantage in regard to shipping facilities which has proven a great handicap in building and picking up the trade now being neglected by our contemporaries in the Old World.

The situation relating to trade carrying facilities was far from satisfactory even in normal times, and our commercial expansion depended largely upon transportation offered by foreign carriers, which made it immeasurably more difficult after the European war was declared. From statistics it may be of interest to record that American ships carried less than 15 per cent of the $6,500,000,000 in merchandise imported and exported by the United States during the fiscal year of 1915-16.

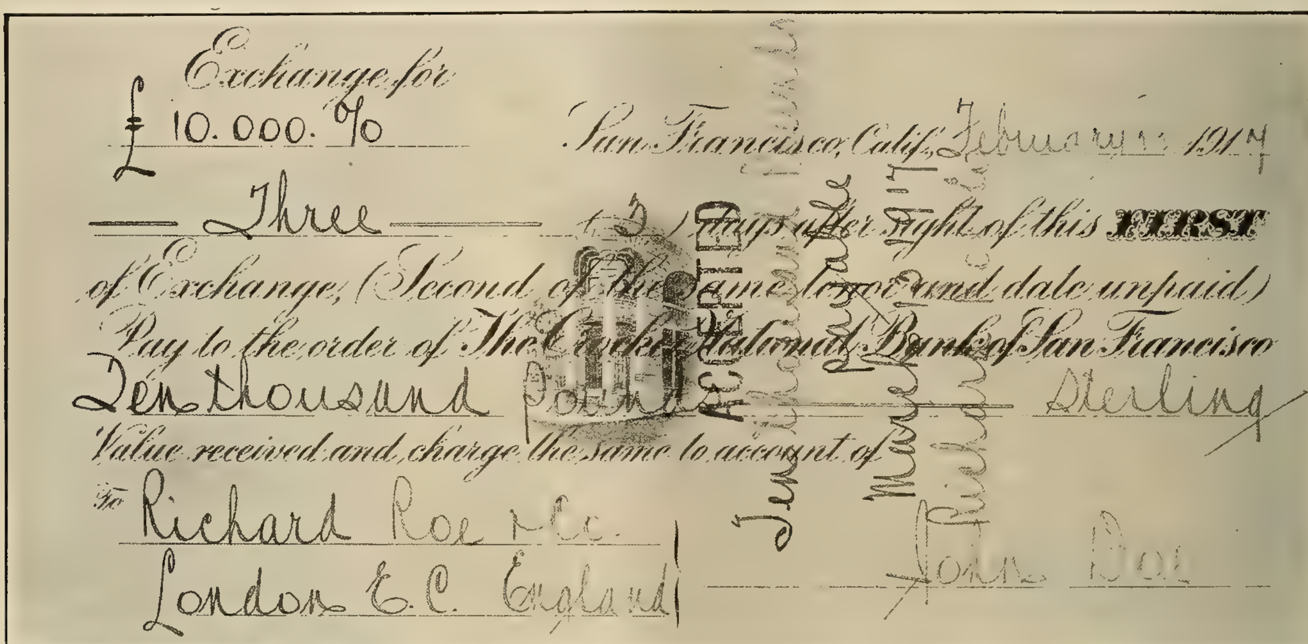
Unloading Transpacific Ships Without the Means of Wharves at Hong Kong—the Second Greatest Shipping Port in the World

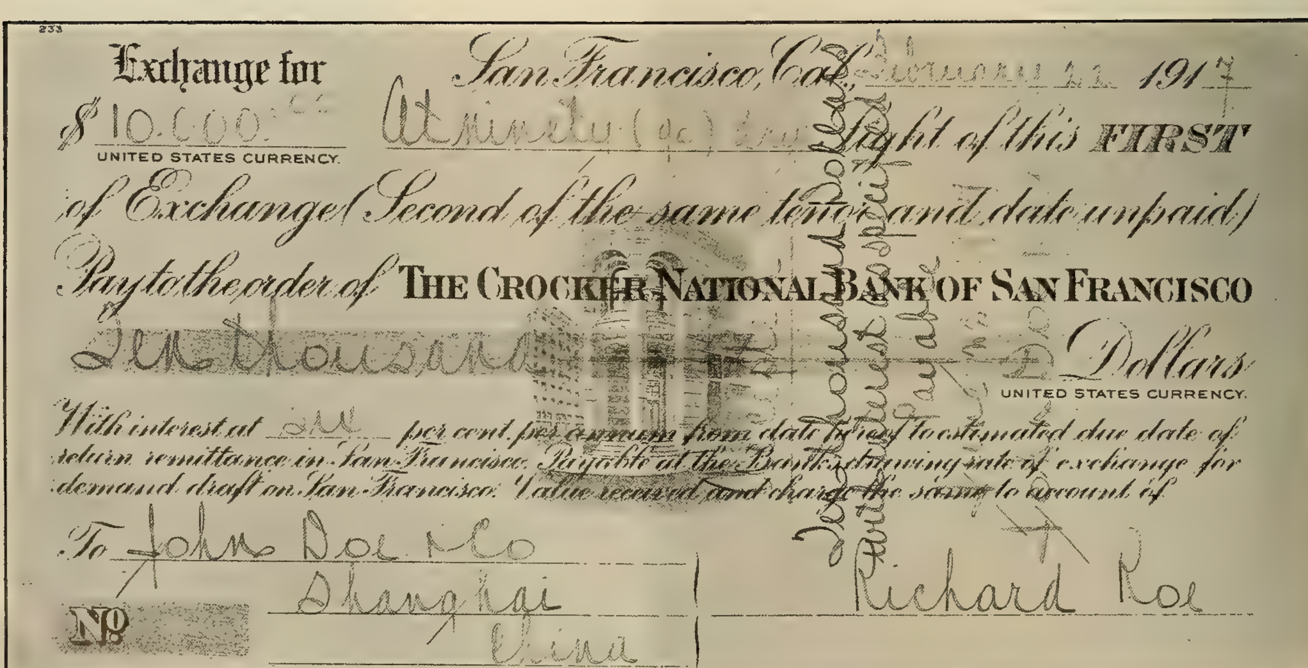
Obviously, a building up of a normal business activity is not to be expected until the usual channels of trade are opened and the many financial menaces removed.

Adequate Banking Facilities Essential.—Just as conditions differ in the various sections of the United States, so do we find a great diversity in systems and methods of operation in foreign countries. It becomes necessary for us to study these essential requirements in seeking adequate channels for expansion of our import and export trade and then arrange for the corresponding financial support to establish banking connections in caring for and promoting our business and financial interests.

We are all aware that there is an undoubted tendency on the part of our commercial element in an endeavor to enlarge the scope of functions performed by banks. It is possible that the conservatism natural and proper to bankers leads them to view such progressiveness too critically, but just as the conception of a banker's function has been vastly widened since the days of old, so the process will continue in the days that are to come. Developments of this kind are healthy, and wise men will not be disposed to obstruct them.

Commercial Acceptances in the Development of Trade.—The new bank act is essentially intended—as a commercial banking system—to assist in the financing of our internal and external trade and provide a market for commercial acceptances based upon the importation and exportation of goods—at the same time create a basic condition of automatic registra-


Exchange for
£ 10.000 00/00 San Francisco, Calif., February 1917
Three (3) Days after Sight of this FIRST of Exchange, (Second of the same tenor and date unpaid)
Pay to the order of The Crocker National Bank of San Francisco
Ten thousand Pounds Sterling
Value received and charge the same to account of
To Richard Roe & Co.
London E.C. England
John Doe


Exchange for San Francisco, Cal., February 1917
$10.000 00/00 At ninety (90) days Sight of this FIRST
UNITED STATES CURRENCY
of Exchange (Second of the same tenor and date unpaid)
Pay to the order of THE CROCKER NATIONAL BANK OF SAN FRANCISCO
Ten thousand Dollars
UNITED STATES CURRENCY.
With interest at six per cent per annum from date hereof to estimated due date of return remittance in San Francisco. Payable at the Bank's drawing rate of exchange for demand draft on San Francisco. Value received and charge the same to account of
To John Doe & Co
Shanghai
China
Richard Roe
No.

Typical Commercial Acceptances on London, England, and Shanghai, China

tion of such operations, which is a very vital feature to prevent over-extension of credit. In the case of time bills of exchange drawn on and accepted by banks or bankers of high standing, there is practical uniformity of security—which cannot be claimed for "commercial paper" with which the financial markets here are supplied, the strength of such obligations depending upon the standing of miscellaneous commercial interests.

While we cannot hope to see the New York or San Francisco bill of exchange take the place of the so well and favorably known bills on London, Hamburg or Paris, recent events and dislocation of the financial structure in Europe have at least brought the possibility before the commercial world and tended to bring within our reach the power of competing on terms of equality with our European contemporaries.

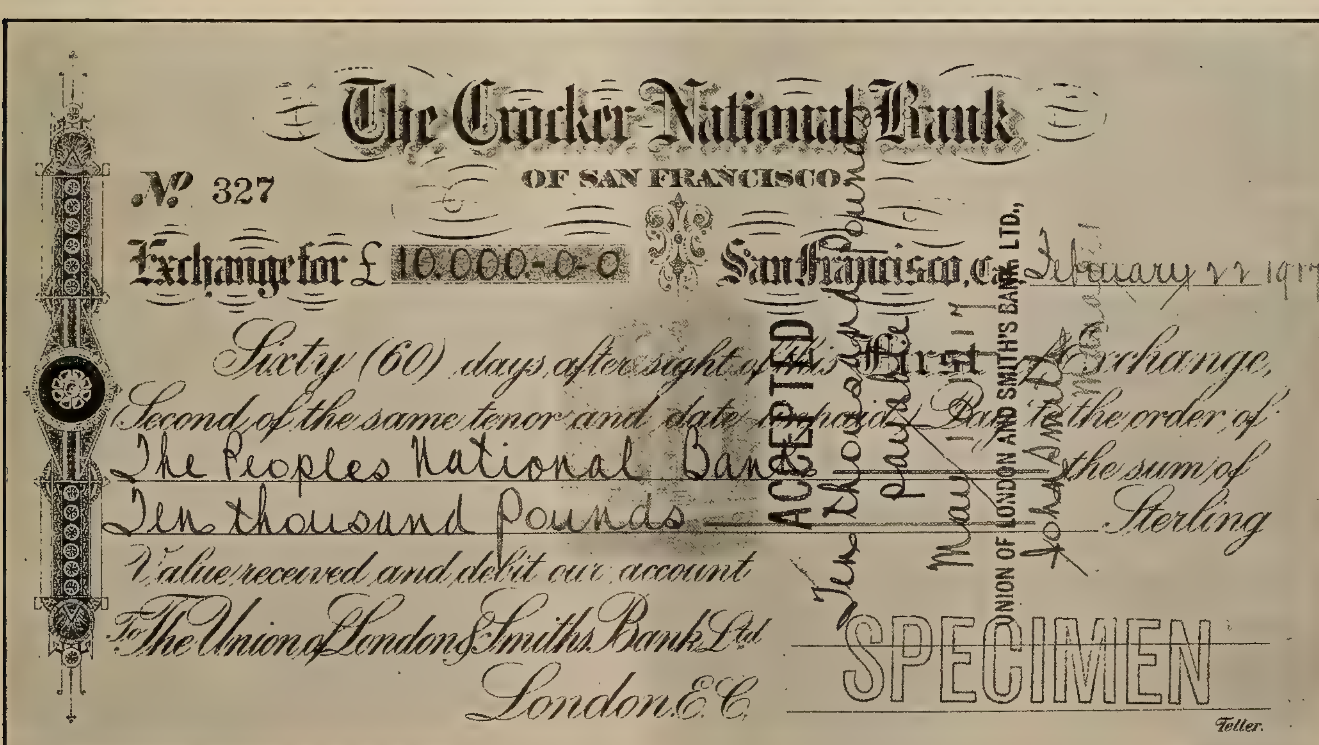
The power of a bank to accept a draft or bill of exchange enables it to make use of and to sell for a consideration its credit, and so lend, for legitimate use in trade, vast sums without depleting its reserve or impairing its capability in making additional loans and advances to its clients.

Whereas the act permits member banks to accept bills of exchange, they are not at present authorized to extend such facilities to clients for the acceptance of drafts covering domestic transactions, although a recent ruling of the Federal Reserve Board provides that where the funds resulting from acceptances are intended to produce the merchandise for ultimate export, or where such funds are to be applied to the purchase of goods to be shipped abroad from the United States, the acceptance privilege on the part of national banks can be invoked. The New York banking law gives permission to state banks and trust companies of extending these facilities for both foreign and domestic transactions. This is likewise the case in Maryland, Utah, Vermont and Texas—the latter restricted to foreign acceptances only—but the laws of other states carry no provision for banks extending to their customers the use of its credit in the development of commercial relations, and it would seem apparent that state bank legislation throughout the United States be amended to harmoniously conform to the new and better system.

A merchant, for instance, instead of borrowing cash on a note from his banker may arrange—for a stipulated commission charge—to use the bank's credit for a certain length of time and a given amount. To make use of such facilities a time-draft may be issued against the bank, which in turn gives the required acceptance. After this requisite has been secured the merchant is in position to either use the bill of exchange in the settlement of his trade obligations or sell it through a bill broker in the open market and so obtain available cash. The small merchant's paper—endorsed by his bank—is as acceptable as that of the largest merchant or corporation, backed as it is by security of the bank and therefore readily discountable by virtue of its high intrinsic security as the most liquid form of investment.

The world's commerce is almost in its entirety financed by bills of exchange, which in turn act as an index to the value of money. Increased trade, both domestic and foreign, very logically brings about a corresponding damand for credit, and while it may be comparatively easy to create credit, it is often a difficult matter to protect it, which, economically claimed, can only be done by maintaining an adequate amount of gold.

The Federal Reserve Bank, with its holding of "gold and lawful money," can, for this reason, very effectively find employment of its resources in fostering and rendering assistance in the financing of our trade, as also in the creation of a broader market in foreign centers for the American bank credit, and



The Crocker National Bank
OF SAN FRANCISCO
No. 327
Exchange for £ 10,000-0-0 San Francisco, Cal. February 22 1917
Sixty (60) days after sight of this First of Exchange, Second of the same tenor and date unpaid, Pay to the order of
The Peoples National Bank the sum of
Ten thousand Pounds Sterling
Value received and debit our account
To The Union of London & Smiths Bank Ltd
London E.C.
ACCEPTED
UNION OF LONDON AND SMITH'S BANK LTD.,
SPECIMEN
Teller.

A Specimen Form of Banker's Acceptance

especially in the recognition of the United States dollar acceptance.

The Discount Market in Relation to Trade.—The matter of a ready discount market—comparing favorably with prevailing conditions in principal centers abroad—is worthy of very serious consideration, and while the feature of discount and rediscount provided for in the Federal Reserve Act may, in the main, be regarded as in the nature of a safety measure, it is hoped that as a principal aid to a more liberal system of financing our domestic and foreign trade, the American market may effectively adjust its rates to conform with those prevailing in other financial centers of the world. As an example of quotations from the discount market, the following is typical for such operations in New York:

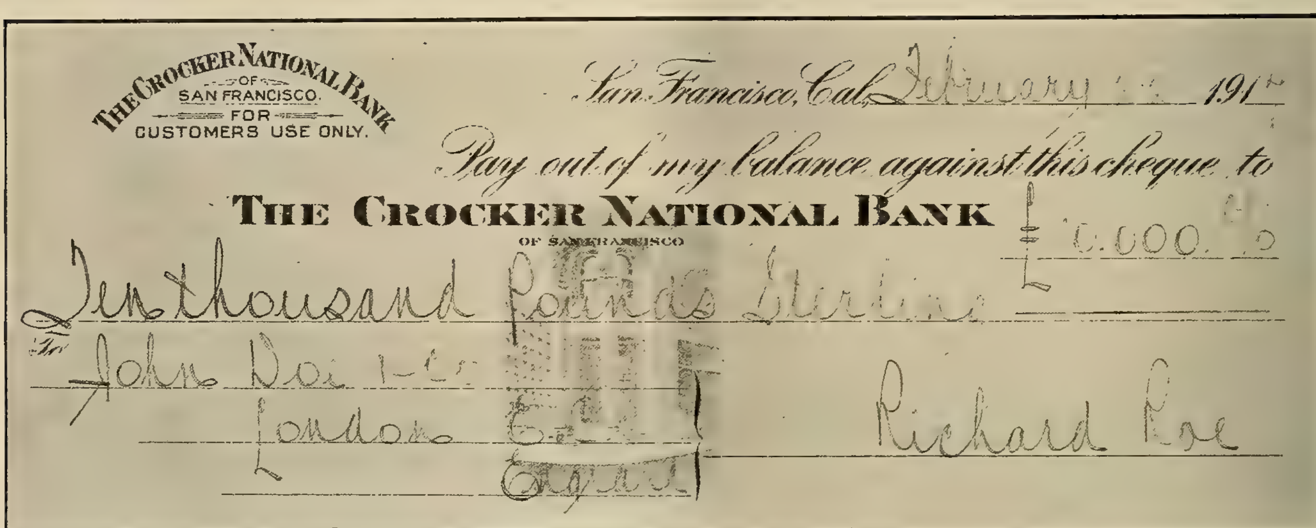
Of course, the value of money apart from the question of whether the open market rate of discount is slightly under or over the Federal Reserve Bank rate, will be governed by the strength of that institution, and the prospect of a demand upon its stock of gold reserve, as is the case with our British friends and their relations with the Bank of England.

Single name paper will not create a discount market as we find in London, Paris and Germany, where the fluctuations of rates so largely depend on the demand for and supply of marketable bills of exchange, which owe their origin to trade transactions as balanced against the demand for and supply of money. Low discount rates are an incentive to the revival of trade, and advancing rates in turn act as a natural check on trade and produce a gradual increase or decrease in the demand for money.

While these conditions are symptoms in governing the discount rates in Europe, our "call loan" rate as quoted in our Eastern markets only has an indirect relation to trade conditions, and registers mainly the speculative demand for stocks.

On the efficiency of the Federal Reserve Act must depend to a large extent the prospects of a great and favorable change in the international position of the United States which will now enter into the competitive field of operations of other great financial nations.

New York:	Last Week	Previous Week	Year to Date High	Year to Date Low	—Same Week— 1916	—Same Week— 1915
Call loans	2½@2	3 @2½	3	1¾	2¼@1¾	2½@1⅞
Time loans, 60-90 days	4½@4	4½@3¼	4½	2½	3 @2½	3 @2½
Six months	4½@4	5 @4	5	2¾	3¼@2¾	3½@3¼
Commercial discounts, 4-6 months	4½@4	4	4½	3	3½@3	4 @3½


The Crocker National Bank of San Francisco. For Customers Use Only.

San Francisco, Cal. February 1917

Pay out of my balance against this cheque to

The Crocker National Bank of San Francisco £10,000

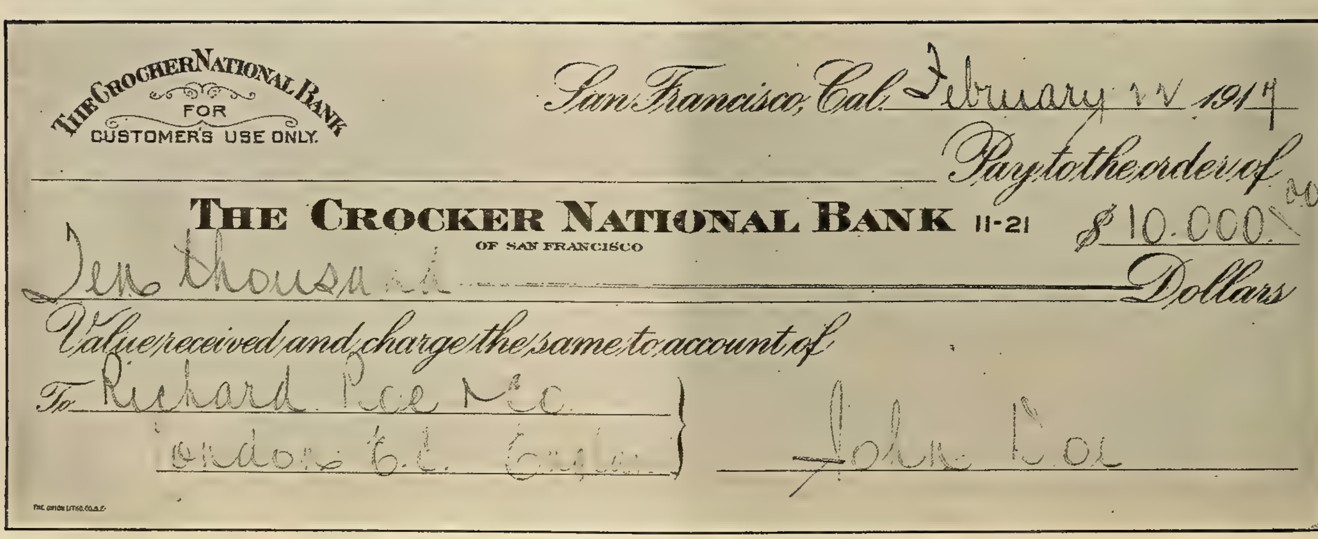
Ten thousand Pounds Sterling

To John Doe & Co.

London E.C.

England

Richard Roe


The Crocker National Bank. For Customer's Use Only.

San Francisco, Cal. February 1917

Pay to the order of

The Crocker National Bank of San Francisco 11-21 $10,000.00

Ten thousand Dollars

Value received and charge the same to account of

To Richard Roe & Co.

London E.C. England

John Doe

Typical Banker's Sight Draft and Commercial Sight Exchanges

THE ANALYSIS OF DISCHARGE RECORDS

BY FRED F. HENSHAW

(The intelligent study of discharge records is of highest importance in hydroelectric development of water resources. Here is a timely discussion on this subject that will appear in three separate papers distinct in themselves, but which collectively cover all the essential features of methods of graphic analysis of discharge records. The author is district engineer of the U. S. Geological Survey at Portland, Ore., and these data are published in our columns by permission of the Director of the U. S. Geological Survey.—The Editor.)

The Water Resources Branch of the United States Geological Survey is the government bureau to which is delegated the measuring of streams and the investigation of water supply and run-off in the United States. This work has been increasing in scope and importance for more than 20 years, and records are now being secured at more than 1300 points, including over 900 west of the 95th meridian and between 500 and 600 on streams flowing into the Pacific Ocean.

The stream-discharge data collected by the Water Resources Branch are used and studied by the engineers of government departments, including the Land Classification Board, U. S. Reclamation Service, U. S. Engineer Office, by states, and by private individuals and corporations, such as power companies, and irrigation companies and districts. The object is to secure information that will be of the greatest value to such users and as complete as is consistent with accuracy.

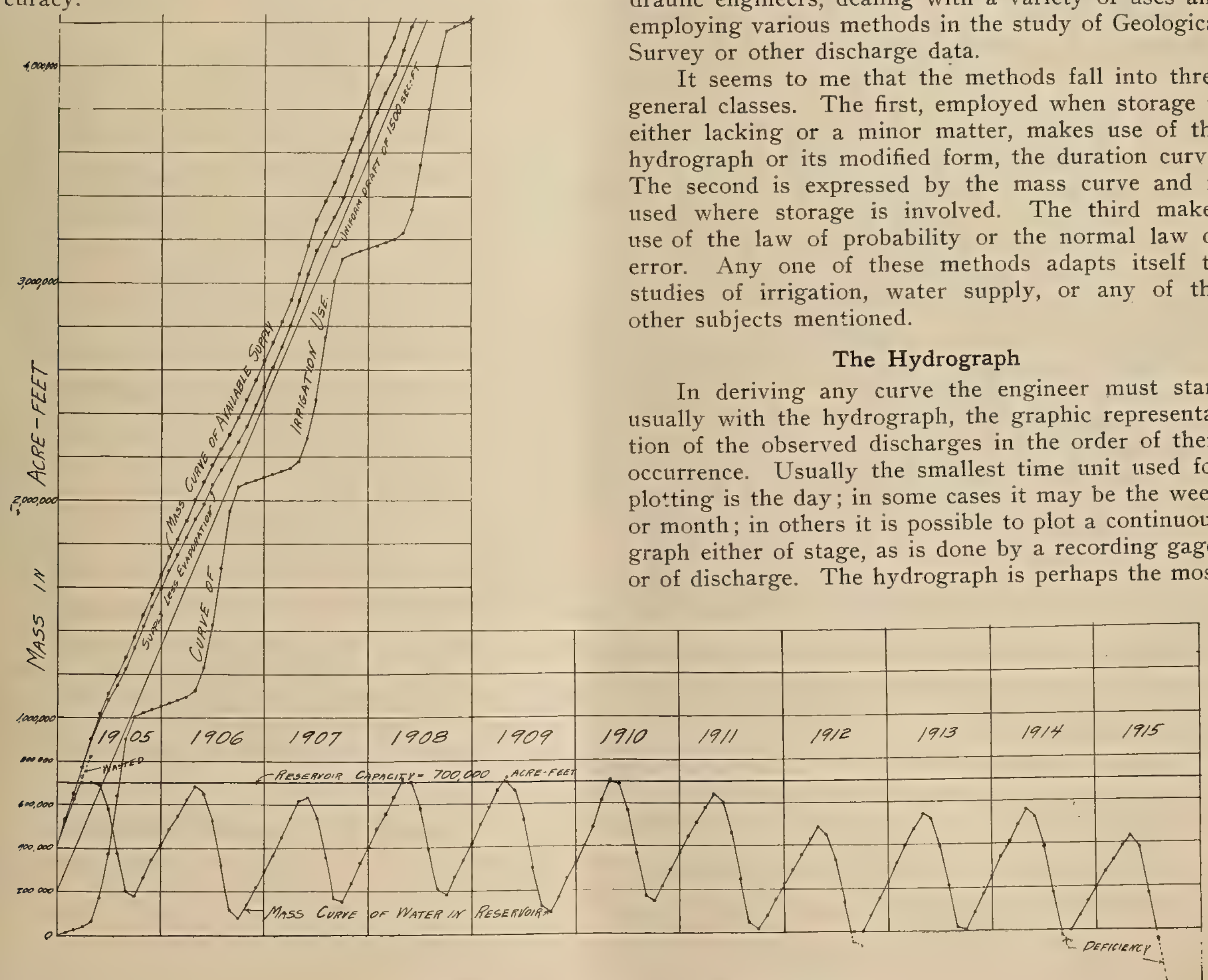
The purpose of this paper is to review briefly some methods of analysis used by engineers in studying the data as published by the Survey and to present some tentative conclusions on the sufficiency of such information for their needs, and not to consider its use in connection with operation for either power or irrigation. The study of past performances of a stream is presented as a guide to what may be expected in the future planning of new developments.

River-discharge data are analyzed in the study of various problems of water utilization, water power, irrigation, municipal supply, flood control, and navigation, which are probably noted in relative order of their present utility; that is, taking the United States as a whole, there are more studies made in the interest of water power than for any other purpose, those for irrigation being a close second. In preparing this report I have gone over a number of reports by hydraulic engineers, dealing with a variety of uses and employing various methods in the study of Geological Survey or other discharge data.

It seems to me that the methods fall into three general classes. The first, employed when storage is either lacking or a minor matter, makes use of the hydrograph or its modified form, the duration curve. The second is expressed by the mass curve and is used where storage is involved. The third makes use of the law of probability or the normal law of error. Any one of these methods adapts itself to studies of irrigation, water supply, or any of the other subjects mentioned.

The Hydrograph

In deriving any curve the engineer must start usually with the hydrograph, the graphic representation of the observed discharges in the order of their occurrence. Usually the smallest time unit used for plotting is the day; in some cases it may be the week or month; in others it is possible to plot a continuous graph either of stage, as is done by a recording gage, or of discharge. The hydrograph is perhaps the most



The Mass Curve for Study of Discharge Records

expressive curve to the layman that can be drawn. It is the simplest to derive and to comprehend. For many of the more elementary studies the hydrograph is all that is required. On the same graph with it can be shown the curves of water demand or use, and the difference between the two curves shows the excesses or deficiencies lineally in terms of rate of flow or by areas representing the total quantities of water that can be stored or that must be supplied from storage to obviate deficiencies.

The Duration Curve

The curve of duration is derived from the hydrograph by arranging the terms in order of magnitude instead of in order of occurrence. This is usually done for a period of one year, and the graphs for successive years may be superimposed on the same sheet just as the hydrograph for several years may be shown. Such a curve adapts itself especially well to the study of possible power development where storage is lacking, and where it is feasible to market a considerable amount of second-class power or power available for only a part of the year and that can be sold for such a period. It is also of as much value, at least, as a mass curve in cases where a limited amount of storage is available. The storage capacity required to maintain any discharge value may be represented by the area, roughly triangular in shape, between the duration curve and the horizontal line representing the given discharge. The duration curve may be used also in studies of irrigation from the natural flow of a stream that can not be supplemented by storage. Many conditions of crops, climate, soil, and land values justify the use for irrigation of water which may be available for only a part of the irrigating season.

The Mass Curve

The mass curve is derived from the successive summation of the discharges shown in the hydrograph; that is, it is the integral of the hydrograph. It is shown in terms of total quantities, acre-feet, or millions of cubic feet, instead of rates of flow. The rate of flow at any given time is represented by the slope or differential of the curve. The simplest of mass curves is formed by the summation of the observed discharge. This has, of course, a continuous upward direction, varying in slope with the discharge. Underneath this can be drawn a line representing the use of water—either a straight line typifying a uniform draft, as for power, or a curved line representing a non-uniform draft, as for irrigation. The difference in vertical height between the two curves represents the storage in reservoir. This mass curve may be modified by measuring down the draft from the curve of run-off, thus making the height between the horizontal axis and the lower graph represent the storage in the reservoir.

These curves are exemplified in Fig. 1, which shows a study of the run-off of Deschutes River, as presented in Water-Supply Paper 344,[1] brought down to 1915. The upper line shows the mass of river discharge corrected in this instance for certain assumed diversions above. A correction has been made for evaporation on reservoir. The line underneath the mass curve shows supply less evaporation. Next is a straight line representing an assumed uniform draft of 1500 second-feet for power. This line has been drawn with the assumption that 200,000 acre-feet of water is stored in the reservoir at the start. The vertical distance between the lines at any point indicates the volume of storage. Thus it is shown that to have conserved all surplus and supplied all deficiencies on the basis of 1500 second-feet continuous flow the reservoir would have filled to about 340,000 acre-feet at the end of May, 1905, and would have been depleted to about 70,000 acre-feet at the end of March 1907. The net storage used to carry over this period of deciency would have been about 270,000 acre-feet. Underneath the straight line showing the uniform draft is a curved line indicating the varying rate of use of irrigation water throughout the successive seasons. In the winter only a small flow is required for domestic and stock water; the heaviest draft comes in June, July and August. The distance between this graph and the second graph shows again the quantity of water in the reservoir. As previously stated, it serves the purpose better to subtract the monthly use from the monthly supply, and secure a curve showing directly the volume in the reservoir, or the bottom curve in the diagram. The lowest horizontal line represents zero storage or reservoir empty. The line of 700,000 acre-feet has been assumed to represent reservoir capacity. The volume in reservoir fluctuates between these lines. When the graph goes over the upper one water is wasted as indicated by a dotted line. When the graph goes below the bottom line there is a deficiency.

The diagram as prepared for the Deschutes report carried the curve to the end of 1912 and showed that the only deficiency occurred in that year and amounted to only about 6 per cent of the yearly use. The years of 1913, 1914 and 1915 proved to be below normal, particularly 1915, when there was a deficiency of 288,000 acre-feet or nearly 28 per cent. This shortage is probably greater than can be allowed. Two courses are open to remedy it—to increase the reservoir capacity, or to reduce the draft. In only one year (1904) was any considerable quantity of water wasted, and it would not be feasible to carry the water over 11 years. The reservoir was last full in 1910. A reduction of annual draft of, say, 25,000 acre-feet would have caused an increase in storage by this amount each year, and would thus have reduced the deficiency at the end of 1915, the sixth year after the reservoir was full, by nearly 150,000 acre feet, or to about 138,000 acre feet, 14 per cent of the yearly use and an entirely permissible deficiency. Study also shows that the reservoir capacity should be reduced. During the first 6 years the quantity of stored water was never reduced to less than 100,000 acre-feet, and in the last 4 years the reservoir has not been filled within 150,000 acre-feet of its capacity. A reduction of 100,000 acre-feet would have caused an additional shortage of about 8 per cent in 1911, but would not have affected any other year. In fact, the U. S. Reclamation Service, in a study made subsequently, assumed a draft about the same as that assumed by the writer, and a total reservoir capacity of about 550,000 acre-feet, and found a shortage in 1912 of about 9 per cent. If this had been carried to the present date it is safe to say that the deficiency in 1915 would have been 20 to 25 per cent, which might or might not be safe.

[1]Henshaw, F. F., Lewis, J. H., and McCaustland, E. J., Deschutes River, Ore., and its utilization: U. S. Geol. Survey Water-Supply Paper 344, 1914.

MILITARY TRAINING FOR ENGINEERS

BY J. D. GALLOWAY AND ALLEN G. JONES

(The solemn scene through which the nation is passing has caused engineers of the West to think more seriously than ever on the probable service each could render to the country in the event of war. This mental activity has crystallized in and about San Francisco, California, in the formation of a course of study whereby engineers may prepare for the Officer's Reserve Corps of the United States Army. The plans thus far matured, detailed below, will undoubtedly receive thoughtful consideration by engineers in all sections of the West.—The Editor.)

A NEW COURSE OF STUDY FOR ENGINEERS TO PREPARE FOR THE OFFICERS' RESERVE CORPS

A joint committee on military affairs of the San Francisco branches of the American Institute of Mining Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers, and the American Chemical Society having received about one hundred and fifty favorable replies from the membership of these branches, are now organizing a complete series of lectures that will open to all engineers and others interested in an officers' reserve corps of the United States Army. J. D. Galloway is chairman and Allen G. Jones is secretary of this committee, to whom all communications should be addressed.

The Joint Committee on Military Affairs recently mailed to the local members of the engineering societies a circular of information regarding the Officers' Reserve Corps of the United States Army, with special reference to (4) Coast Artillery; (9) Quartermaster; (10) Engineer; (11) Ordnance and (12) Signal Corps. It was announced that if a sufficient number of engineers were interested, a study and lecture course would be initiated by this committee, as a preparation for the examinations for commissions in the reserve corps. From the favorable replies that have been received the committee feels justified in proceeding.

Lectures Open to all Engineers and Others Interested

A circular is being sent to all engineers affiliated with the local or National Societies and to other engineers not so affiliated whose addresses are available. The study and lecture course is not confined to those who have already sent cards, but is open to all engineers and to others who may be interested. The courses as planned relate to branches of the service in which engineers would be interested, but if a sufficient number of persons indicate a desire for instruction in other branches of the service, such as infantry or cavalry, special courses of study will be arranged in those branches.

Plan of the Course.—As it was probable that the engineers might be interested in any one of the five different corps named above, arrangements have been made for special instruction therein, but, as certain requirements of the examination are common to all corps, the first lectures are general in their nature applying to all arms and should be attended by all.

The text specified under each course should be studied by a candidate prior to attending lectures.

General Subjects: Lecture Course "A." To be taken by everyone interested.

First Lecture

Lecturer: Major General J. Franklin Bell, commanding Western Department, U. S. Army.
Subject: The United States Army and its Officers and Enlisted Reserve Corps.
Hour and Date: 8 o'clock p. m., Tuesday, March 13, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco.
Text: Fundamentals of Military Service.

Second Lecture

Lecturer: Capt. R. Park, Corps of Engineers.
Subject: General Duties of the Different Arms of the Service.
Hour and Date: 8 o'clock p. m., Tuesday, March 20, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Fundamentals of Military Service.

Third Lecture

Lecturer: To be announced.
Subject: Administration of the U. S. Army.
Hour and Date: 8 o'clock p. m. Tuesday, March 27, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Army Regulations, Edition 1913, Articles 1-23, 29-33, 39, 40, 53, 55, 60; also special articles pertaining to the different corps—Field Service Regulations, Part III.

Fourth Lecture

Lecturer: Captain George M. Marshall, A.D.C. to General Bell.
Subject: Field Service Regulations.
Hour and Date: 8 o'clock p. m., Tuesday, April 3, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Field Service Regulations U. S. Army.

Fifth Lecture

Lecturer: Captain George M. Marshall, A.D.C. to General Bell.
Subject: Infantry Drill Regulations—Small Arms Firing Regulations.
Hour and Date: 8 o'clock p. m., Tuesday, April 10, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Infantry Drill Regulations U. S. Army.

Sixth Lecture.

Lecturer: To be announced..
Subject: Military Law.
Hour and Date: 8 o'clock p. m., Tuesday, April 17, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Manual of Courts Martial. General Orders, No. 4 and No. 52, 1902, A.G.O. Circular No. 65 W.D., 1907, Rules of Land Warfare.

Seventh Lecture

Lecturer: Capt. R. Park, Corps of Engineers.
Subject: Topography.
Hour and Date: 8 o'clock p. m., Tuesday, April 24, 1917.
Place: Native Sons of the Golden West Bldg., 430 Mason street, San Francisco, Cal.
Text: Engineer Field Manual U. S. A., Part 1.
Note: On or before the conclusion of the General Lecture Course, members will please send in to the Military Affairs Committee a statement of the special course which they desire to attend.

SPECIAL SUBJECTS

On conclusion of the General Lecture Course "A," the foling Special Lectures will be given, provided a sufficient number of persons elect to take the courses. Information regarding place, time, the lecturers and texts will be announced later.

LECTURE COURSE "B"

Of value to candidates for commissions in the Coast Artillery Corps.

First Lecture

Lecturer: Captain John B. Murphy, Coast Artillery Corps, A.D.C.
Subject: Coast Artillery Drill.
Text: Coast Artillery Drill Regulations.
(For other lectures, see courses "F" and "G" below.)

LECTURE COURSE "C"

Of special value to candidates for commissions in the Quartermaster Corps.

First Lecture

Lecturer: Lt. Col. Thomas H. Slavens, Dept. Quartermaster.
Subject: General Quartermaster duties and business.

Second Lecture

Lecturer: Lt. Col. Thomas H. Slavens. Dept. Quartermaster.
Subject: Transportation: Land and Water: Hippology.

LECTURE COURSE "D"

Of special value to candidates for commission in the Signal Corps.

First Lecture

Lecturer: Captain Leroy Muller C. A. C.
Subject: Aviation.

Second Lecture

Lecturer: First Lieutenant D. B. Sange', Signal Corps Dept. Signal Officer.
Subject: Signalling, telegraphy, telephony.

LECTURE COURSE "E"

Of special value to candidates for commission in the Ordnance Department and the Coast Artillery.

First Lecture

Lecturer: Major H. W. Schull, Dept. Ordnance Officer.
Subject: Duties of Ordnance Officers.

LECTURE COURSE "F"

Of special value to candidates for commission in the Ordnance and Coast Artillery.

First Lecture

Lecturer: Major H. W. Schull, Dept. Ordnance Officer.
Subject: Mechanical Engineering and Machine Work.

Second Lecture

Lecturer: Captain John B. Murphy, Coast Artillery Corps.
Subject: Electrical Engineering and Electricity as Applied to the Coast Artillery Corps.

Third Lecture

Lecturer: Captain John B. Murphy, Coast Artillery Corps.
Subject: Explosives, Primers and Fuses.

LECTURE COURSE "G"

Of special value to candidates for Coast Artillery Corps, Signal Corps, and Engineer Corps.

First Lecture

Lecturer: Captain R. Park, Corps of Engineers, Assistant to Department Engineer.
Subject: Duties of engineer officers and proper co-operation between various arms of the Service—Search Lights—Field Fortifications.
Text: Engineer Field Manual—Technique of Modern Tactics, Chapters 8, 9, 11, 12—Bulletin No. 4, Vol. 1, O.C.S.

Books

The following books are recommended by the office of the Chief of Engineers:

U. S. Army Regulations, 1913, Supt. of Documents, Washington, D. C.	$ .50
Military Railways, Professional Papers No. 32, Corps of Engineers, Supt. of Documents, Washington, D. C.	.50
Field Service Regulations, Supt. of Documents, Washington, D. C.	.60
Infantry Drill Regulations, Supt. of Documents, Washington, D. C.	.35
Manual of Courts Martial, Supt. of Documents	1.00
Engineers Field Manual, Supt. of Documents, Washington, D. C.	1.00
Bulletin No. 4, Vol 1, O.C.S., Adjutant General, U. S. Army, Washington, D. C.	Free
General Order No. 6, 1915, Adjutant General, U. S. Army, Washington, D. C.	Free
General Order No. 52, Adjutant General, U. S. Army, Washington, D. C.	Free
Circular No. 65. War Dept., 1907	Free
Fundamentals of Military Service, Andrews Army Service Schools, Book Dept., Fort Leavenworth, Kansas	1.50
Technique of Modern Tactics, Army Service Schools, Book Dept., Fort Leavenworth, Kansas	2.65
Notes on Field Fortifications, Army Service Schools, Book Dept., Fort Leavenworth, Kansas	.30
Studies in Minor Tactics, Army Service Schools, Book Dept., Fort Leavenworth, Kansas	.50

For those who contemplate commissions as 1st and 2d lieutenants, "Field Service Regulations," 60c.; "Infantry Drill Regulations," 35c.; and "Fundamentals of Military Service," $1.50, a total of $2.45, together with Orders and Circulars, will probably be sufficient. For those who contemplate commissions as captain or major, "Technique of Modern Tactics," $2.65, added to the above will probably be sufficient. If possible, the entire set should be obtained.

The committee will obtain any of these books, provided a request accompanied by the price is sent in by March 1, 1917. If a sufficient number of books are ordered at one time the Army Service Schools, Book Department will give a discount of 20 per cent, on their publications only. The "Fundamentals of Military Service" can be obtained from Technical Publishing Company, Crossley Bldg., San Francisco, who will give a 10 per cent discount.

Expenses

The only cost additional to the above for books will be $1.50 for each one taking the course, to cover expenses of printing, postage, hall rent, stenographer, etc. Make checks payable to the Military Affairs Committee.

Correspondence Course

In the original circular a statement was made of a possible correspondence course. The number of replies received does not warrant this action. Engineers who cannot attend the lectures may, however, by following the reading announced, prepare themselves for the examinations. The committee will obtain books at cost and will endeavor to answer questions.

VAST SHIPBUILDING ON PACIFIC COAST

The Launching of the Thordis in Oakland

THE ever-increasing activity of ship-building on the Pacific Coast is daily drawing the attention of engineers of the West to the electrical possibilities of the future in this phase of commercial development. Much has appeared in the technical press relative to the general proportions of this awakened industry. Little has been published, however, in the way of specific listings of the present status of actual ships now under construction.

In much of this new building electric and turbine operation will find new applications. The Maui, for instance, which is now building at the Union Iron Works in San Francisco, is being installed with geared turbine propelling machinery and will be the first large passenger vessel in this country so equipped. Most of the vessels thus far equipped with geared turbines have been single screw and of comparatively small power—from 2000 to 3000 horsepower, whereas this installation is twin screw and will develop 10,000 h.p. at full speed. At a later date there will appear in the columns of the Journal detailed descriptions of many of these new and interesting achievements in marine engineering now being brought about in Pacific Coast ship yards.

From government commerce reports the total tonnage in shipbuilding now under way in the United States is as follows:

Kinds.	Number.	Gross tons.
Steel merchant ships	403	1,495,601
Wooden merchant ships	161	207,623
Total merchant construction	564	1,703,224
		Displacement, tons.
Government vessels:		
Steel, navy yards and private yards	118	395,537
Grand total	682	2,098,761

The Pacific Coast is well represented in this activity and the increased uses of electrical applications in modern marine service make the statistics of shipbuilding on the Pacific Coast of unusual interest to engineers of the West. In detail the work now under way is as follows:

Seattle Construction & Dry Dock Co., Seattle, Wash

Merchant Vessels

Vessel	Gross Tonnage	Speed Knots	Owner	Trade	Probable Date of Launch
Panuco	3,900	12	New York & Cuba Mail Steamship Co	Cargo	Launched
No. 88	7,500	..	A. O. Andersen & Co., Den	Cargo	Feb 1, 1917
No. 89	7,500	..	A. O. Andersen & Co., Den	Cargo	Apr 1, 1917
No. 90	7,500	..	A. O. Andersen & Co., Den	Cargo	Mar 1, 1917
Walter A. Luckenbach	8,000	12	Edgar F. Luckenbach	Cargo	Apr 1, 1917
No. 92	4,300	10½	For Norwegian account	Cargo	May —, 1917
No. 93	4,700	10½	For Norwegian account	Cargo	Late 1917
No. 94	4,700	10½	For Norwegian account	Cargo	Late 1917
No. 95	4,700	10½	For Norwegian account	Cargo	Late 1917
No. 96	4,700	10½	For American account	Cargo	Late 1917

War Vessels

Vessel	Displacement Tons	Speed Knots	Type	Contract Price	Probable Date of Completion
Gwin	1,123	30.0	Destroyer	$ 885,000	Nov. 8, 1917
N-1	....	....	Submarine	450,000	May 19, 1917
N-2	....	....	Submarine	450,000	June 19, 1917
N-3	....	....	Submarine	450,000	July 19, 1917
Scout Cruiser No. 4	7,100	35.0	Scout cruiser	4,975,000	June 26, 1919

INTERSTATE BRIDGE SPANNING COLUMBIA RIVER, WITH FULL ALLOWANCE FOR NEW SHIPPING INDUSTRY

The great structure built by the people of Clarke County, Washington, and Multnomah County, Oregon, to facilitate traffic between the two states and form a connecting link in the Pacific highway, is opened. General view (above) of the bridge over the main channel of the Columbia. This section contains 14 spans and is 3530 ft. long. The structure is really three bridges, with total length of 17,300 ft. It consists of a main bridge over the Columbia, a bridge over the Columbia Slough and a bridge over the Oregon Slough. The cost was $1,750,000, of which Clarke County paid $500,000 and Multnomah County $1,250,000. The total weight of steel in the structure is 16,696,000 pounds.

Union Iron Works Co., San Francisco

Merchant Vessels

Vessel	Gross Tonnage	Speed Knots	Owner	Trade. Cargo and Passenger	Probable Date of Launch
Maui	9,728	16	Matson Navigation Co.	Cargo and Passenger	Launched
J. W. Van Dyke	7,200	11	Atlantic Refining Co.	Bulk Oil	Launched
Southerner	6,200	11	Walker-Armstrong Co.	Cargo	Feb. —, 1917
Annette Rolph III	6,200	11	Rolph Navigation & Coal Co.	Cargo	Feb. 15, 1917
Fred W. Weller	10,500	11	Standard Oil Co., of New Jersey	Bulk Oil	July —, 1917
A. C. Bedford	10,500	11	Standard Oil Co., of New Jersey	Bulk Oil	Aug. —, 1917
Eagle	6,200	11	Standard Transportation Co.	Cargo	Jan. —, 1917
Tiger	6,200	11	Standard Transportation Co.	Cargo	Feb. 25, 1917
Talabot	6,200	11	N. S. Bjonnes & Son, Nor.	Cargo	Launched.
No. 139	6,200	11	Christian Smith, Nor.	Cargo	Jan. 30, 1917
No. 140	7,200	11	Wilhelm Jebsen, Nor.	Bulk Oil	June 15, 1917
No. 141	7,200	11	Pan American Petroleum & Transport Co.	Bulk Oil	Apr. 15, 1917
No. 142	6,200	11	Not given	Cargo	June —, 1917
No. 143	7,200	11	Atlantic Refining Co.	Bulk Oil	June 26, 1917
No. 144	7,200	11	Atlantic Refining Co.	Bulk Oil	July 22, 1917
No. 145	7,200	11	Pan American Petroleum & Transport Co.	Bulk Oil	Aug. 17, 1917
No. 146	7,200	11	Pan American Petroleum & Transport Co.	Bulk Oil	Sept. —, 1917
No. 147	7,200	11	Not given	Bulk Oil	Dec. —, 1917
No. 148	7,200	11	Atlantic Refiining Co.	Bulk Oil	July —, 1917
No. 149	7,200	11	Atlantic Refiining Co.	Bulk Oil	Sept. —, 1917
No. 150	5,950	11	Not given	Cargo	May 20, 1917
No. 151	5,950	11	Not given	Cargo	June 20, 1917
No. 152	....	..	Builder's account	Floating Dry Dock	*Jan 5, 1917
No. 153	6,200	11	Not given	Cargo	Dec —, 1917
No. 154	3,600	9½	A. O. Lindvig, Nor.	Cargo	Sept —, 1917
No. 155	....	..	Builder's account	Caisson for Floating Dry Dock	
At Alameda yard:					
No. 16	3,600	9½	C. H. Smith, Nor.	Cargo	Jan —, 1917
No. 17	3,600	9½	Willy C. Gilbert, Nor.	Cargo	Mar 30, 1917

*Launched.

California Shipbuilding Co., Long Beach, Cal

L-6	Submarine	$560,000	Apr 1, 1917
L-7	Submarine	560,000	May 1, 1917
O-14	Submarine	548,500	Mar 1, 1918
O-15	Submarine	548,500	Apr 1, 1918
O-16	Submarine	548,500	May 1, 1918

Moore & Scott Iron Works, Oakland, Cal

Therdes	5,000	..	O. T. Tvennerald, Norway	Cargo.	Launched July —, 1917
No. 111	6,000	..	Huasteca Petroleum Co.	Bulk Oil	July 1, 1917
No. 112	4,600	..	For Norwegian account	Cargo	July 1, 1917
No. 113	5,000	10½	For Norwegian account	Cargo	June —, 1917
No. 114	5,000	10½	For Norwegian account	Cargo	July —, 1917
No. 115	5,000	10½	For Norwegian account	Cargo	Oct. —, 1917

Skinner & Eddy Corporation, Seattle, Wash

No. 3	6,400	10½	Standard Oil Co. of New Jersey	Bulk Oil	Feb —, 1917
No. 4	6,400	10½	Standard Oil Co. of New Jersey	Bulk Oil	May —, 1917
No. 5	5,730	11½	Builder's Account	Cargo	Feb. —, 1917
No. 6	5,730	11½	Builder's account	Cargo	June —, 1917
No. 7	5,730	11½	Not given	Cargo	Aug —, 1917
No. 8	5,730	11½	Not given	Cargo	Nov —, 1917
No. 9	5,730	11½	Not given	Cargo	Dec —, 1917
No. 10	5,730	11½	Not given	Cargo	Dec —, 1917
Elizabeth Gibbs	5,730	..	Not given	Cargo	Spring 1918

J. F. Duthie & Co., Seattle, Wash

No. 8	5,730	10½	Torpe & Weise, Nor.	Cargo	Summer 1917
No. 9	5,730	10½	Peder Kleppe, Nor.	Cargo	Summer 1917
No. 10	5,730	10½	Willy Gilbert, Nor.	Cargo	Summer 1917
No. 11	5,730	10½	Lauritz Kloster, Nor.	Cargo	Fall 1917.
No. 12	5,730	10½	Lauritz Kloster, Nor.	Cargo	Fall 1917.
No. 13	5,730	11	For Norwegian account	Cargo	Fall 1917.
No. 14	5,730	..	For Norwegian account	Cargo	1918 delivery.

Albina Engine & Machine Works, Portland, Ore

No. 1	3,300	10	Ragnvald Jacobsen, Nor.	Cargo	Aug —, 1917
No. 2	3,300	10	Redereiaktiebolegat Altran, Falkenburg, Swe.	Cargo	Oct —, 1917
No. 3	3,800	12	S. S. Co., Viking, Den	Cargo	Dec —, 1917
No. 4	3,800	12	S. S. Co. Skjold, Den	Cargo	Mar —, 1918
No. 5	3,800	12	S. S. Co. Carl, Den	Cargo	May —, 1918
No. 6	3,800	12	S. S. Co., Gorm, Den	Cargo	July —, 1918

Anderson Steamboat Co., Seattle, Wash

———	5,700	10½	Hannevig Bros., Nor.	Cargo	....
———	5,700	10½	Hannevig Bros., Nor.	Cargo	....

TIME PHENOMENA OF INTEREST TO ENGINEERS

(In the issue of February 15, 1917, under the column headed Sparks, there appeared a statement that, although the net increase in the day begins on December 21 each year, still the sun does not begin to rise earlier until ten days later. Due to the present nation-wide discussion devoted to setting clocks ahead an hour, a brief review of the astronomical explanation of the phenomena above alluded to should prove interesting and instructive to readers of the Journal. Here are two letters, one from the students observatory at Berkeley and the other from the director of the great Lick Observatory at Mt. Hamilton, which should entirely clarify the matter.—The Editor.)

Sir:—The statement is correct. The sun does not begin to rise earlier until about the 9th of January, but it sets from one to two minutes later during this interval giving a continually increasing length of duration of daylight. The reason is due to what is technically called the "Equation of Time." Civil time is not regulated according to the true sun, but according to a fictitious body called the mean sun which is assumed to move along the equator at a uniform daily rate. The motion of the true sun is non-uniform, owing to the eccentricity of the earth's orbit, and also to the fact that it moves on the ecliptic and not on the equator.

Following the 21st of December the true sun is moving easterly with respect to this mean sun, so that the clock time (civil time) of the rising of the true sun becomes later daily owing to this fact; but on account of the true sun coming north then there is a tendency for it to rise earlier. These two effects just about balance each other for several days until about January 9th, when the northerly motion of the sun begins to have the greater effect on the time of sunrise. From this date on then the sun begins to rise earlier daily.

It is due to these same causes that the difference between civil time and sun-dial time is variable throughout the year.

R. T. CRAWFORD,
Director Students Observatory, University of California.

Sir: Your statement that the sun did not begin to rise earlier in the ten days following December 21 is correct. In fact, you could have made it stronger in the same direction and still be well within the truth. The explanation lies in what astronomers call the equation of time. The earth's speed in its annual travels around the sun is variable because it is following an elliptic orbit and not a circular orbit. This speed is much higher on January 1, when the earth is in perihelion, than it is about July 1, when the earth is at aphelion. The speed decreases continuously from January 1 to July 1, and increases continuously from July 1 to January 1. The fact that the plane of the earth's orbit—that is the ecliptic—does not coincide with the plane of the earth's equator, but is inclined at about 23½ degrees, is likewise a factor in the problem. Both of these factors affect the times, by our clocks and watches, at which the center of our sun crosses our meridian at noon.

A true solar day at any point on the earth is the interval between two successive transits of the center of the sun over the meridian of that point. The true solar days are of different lengths. It is therefore far from practicable to use the sun as the direct regulator of our clocks and watches. It is not practicable to construct a clock which would take these irregularities into account, and such a clock, even if it could be constructed, would not be a desirable one for the use of the people, for the hours, minutes and seconds on such a clock would be of different lengths in different months, weeks and days.

Recourse is had to a fictitious or mean sun which comes to meridian passage at equal intervals, called the mean solar day. The mean solar day is in length the average of all the true solar days in the year. The true sun is a little west of the mean sun in certain parts of the year and a little east of the mean sun in other parts of the year. On December 21 the true sun was a little west of, and rose two minutes of time before, the mean sun. On January 1 the true sun was east of, and rose 3.6 minutes after, the mean sun. On January 11 the true sun rose 8.0 minutes after the mean sun. We can therefore see that the rising of the sun in the twenty-one days following December 21 was more and more belated because the true sun was getting farther and farther to the east of the fictitious or mean sun which governs our clocks and watches.

The following table gives the Pacific Standard times of sunrise and sunset, and likewise the length of the interval between sunrise and sunset, at Mount Hamilton for the four dates concerned.

	Sunrise	Sunset.	Length of Day.
1916—December 21...	7 hr. 20 min.	4 hr. 51 min.	9 hr. 31 min.
1917—January 1...	7 hr. 23 min.	4 hr. 58 min.	9 hr. 35 min.
January 11...	7 hr. 23 min.	5 hr. 07 min.	9 hr. 44 min.
January 21...	7 hr. 19 min.	5 hr. 17 min.	9 hr. 58 min.

The sun rose a fraction of a minute later by our watches on January 6 than it did on January 1 and January 11.

The position of the real sun with reference to the fictitious (mean) sun which governs our clocks and watches is indicated in the following table for the beginning and middle of each month:

Jan. 1........	Real sun is	3.6	minutes	east	of	fictitious sun
16........	" " "	9.8	"	"	"	" "
Feb. 1........	" " "	13.7	"	"	"	" "
15........	" " "	14.3	"	"	"	" "
Mar. 1........	" " "	12.5	"	"	"	" "
16........	" " "	8.8	"	"	"	" "
Apr. 1........	" " "	4.0	"	"	"	" "
16........	" " "	0.1	"	west	"	" "
May 1........	" " "	3.0	"	"	"	" "
16........	" " "	3.8	"	"	"	" "
June 1........	" " "	2.5	"	"	"	" "
16........	" " "	0.3	"	east	"	" "
July 1........	" " "	3.5	"	"	"	" "
16........	" " "	5.8	"	"	"	" "
Aug. 1........	" " "	6.2	"	"	"	" "
16........	" " "	4.3	"	"	"	" "
Sept. 1........	" " "	0.1	"	west	"	" "
16........	" " "	5.0	"	"	"	" "
Oct. 1........	" " "	10.2	"	"	"	" "
16........	" " "	14.3	"	"	"	" "
Nov. 1........	" " "	16.3	"	"	"	" "
16........	" " "	15.2	"	"	"	" "
Dec. 1........	" " "	11.0	"	"	"	" "
16........	" " "	4.4	"	"	"	" "
31........	" " "	3.0	"	east	"	" "

The slight easterly motion of the true sun with reference to the mean sun, which had the effect of delaying the times of sunrise on the sixteen mornings following December 21, had also the corresponding effect of delaying the times of setting of the true sun with reference to our clocks and watches; that is, as the true sun was east of the mean sun and moving easterly from the true sun, both the risings and the settings of the true sun were delayed in terms of our clock and watch readings.

You may be interested to know that about February 11 each year the true sun is 14.6 minutes east of the mean sun; and about November 3 the true sun is about 16.4 minutes west of the mean sun.

W. W. CAMPBELL,
Director Lick Observatory.

SHORT JOURNEYS IN PACIFIC LANDS

(Steel cross-ties with concrete-setting have long been used in countries abroad though their application in this country has been scant. Hong Kong, the second largest shipping port in the world, has of necessity forced the engineer to perform an unusual accomplishment in making habitable a precipitous mountain immediately in the rear of the business section. How this has been accomplished is described in the following article, which is contributed by an American engineer who recently made a visit to all the principal sea-ports of the Orient.—The Editor.)

THE FAMOUS TRAM OF HONG KONG

The Hong Kong Tram With Mammoth Harbor in Distance

DURING the past several months as we have daily followed the accounts of the bloody battles that have been raging in Europe, I doubt if one of us has experienced the passing of a single day without hearing someone quote Sherman's definition of War. If, however, as set forth in this famous saying, war is the only thing that is comparable to give an illuminating concept to the imagination as to the true meaning of the lower region, then we must fail in words sufficient to depict one's feelings on a hot, languid, humid June day in Hong Kong.

Perhaps the English years ago did not express in words their feelings on such days when Hong Kong was young in international importance. At any rate they must have lifted up their heads to the hills from whence came their light for today the residential section of Hong Kong presents at once the most unique and spectacular triumph in engineering ever accomplished in the history of city building.

Immediately back of Hong Kong's superb water front, with the exception of a thin strip reserved for her commercial houses and hotels, the ground rises most precipitously to a height of over 2000 ft. At these higher altitudes the refreshing monsoons, unfelt in the humid business region below make life most desirable and indeed the exquisite scenery and outlook enjoyed from these heights alone, occasioned a longing for the construction of homes along the steep and precipitous sides of the barren mountain.

Hence followed the planting of the mountain side with exquisite shrubbery and the construction of the famous Peak Tramway surrounded on all sides by palatial substantial residences.

The mountain, christened Victoria Hill, is too steep for wagon traffic and the question of a winding railway was entirely beyond consideration as the time for climbing and the cost of construction were too great.

It was decided in 1885 to construct the "Tram," as it is familiarly called in Hong Kong. The road bed is of concrete bedding and is a striking and successful illustration of the use of steel cross-ties which are embedded in the concrete. The cars, two in number, are operated by a steel cable one mile in length. As one car lowers, the other is raised.

Signal wires are stretched along the side of the road bed in order that signals may be sent to the operating house at the top of the hill where the control is maintained and the power driving mechanism installed.

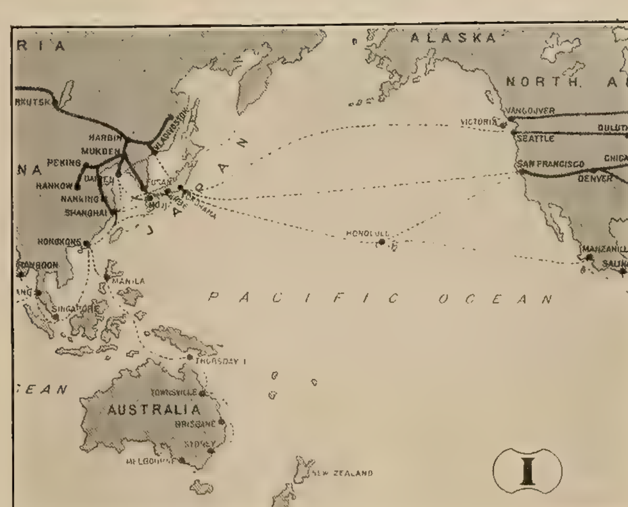
A third rail is installed along the entire route for the purpose of emergency control by means of quickly acting brakes in case of accident. So carefully and successfully has the installation been operated during its thirty years of life that not a single fatal accident has occurred, although thousands upon thousands have been transported up the steep slope.

The fare charge is 50c per round trip in Hong Kong money. This varies in value in the American standard from 23 to 25c.

At intervals of 300 to 400 ft. elevation in the upward journey, stations have been cut at intersecting roads. These level laterals are wonders for permanency in construction. Although used solely for the bare-footed sedan chairmen to bear their burdens to and fro to the Tram, (for the British subject at Hong Kong never walks) the pathways are laid with massive blocks.

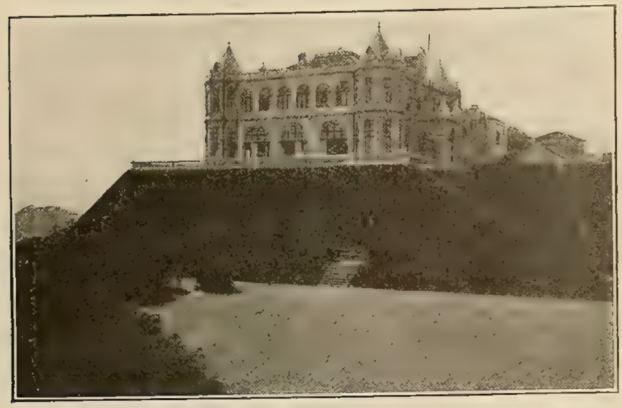
Along these pathways the most beautiful shrubbery has been made to grow and withal Victoria Hill truly presents the appearance of what Paradise is supposed to be.

The buildings which line the pathways leading from the Tram are of massive stone and brick construction built in the most substantial manner. This massiveness of construction is not without its necessities for the violent typhoons which visit Hong Kong



Hong Kong and Other Oriental Ports

from time to time have truly demonstrated that only the most substantial structures can be safely depended upon to withstand at all times their violence. Practically all the materials used in their construction have tediously been drawn up the hill by Chinese women who today may be seen treading their way up the steep pathways bearing burdens of sand and mortar for the buildings now under construction.



The Governor's Residence on Top of the Peak

To cap the climax of architectural and engineering triumph two most palatial structures have been built upon the summit of Victoria Hill. The one is the summer residence of the governor of Hong Kong and the other the Peak Hotel. At the latter place many local families occupy suites of rooms throughout the year and luxuriously enjoy the beauty of scenery and air to be found upon the summit, while the men folk journey back and forth daily to their work in the business district precipitously below.

American engineers, especially those of the electrical engineering professions, interested in development of suburban traffic, will do well to ponder over the possibilities of similar precipitous hills outlying their residential districts, for gigantic outlays of power with its profitable return is in many cases a possibility although without knowledge of this daring but successful precedent, one might well shrink from attempting its development.

METERS FOR ELECTRIC PLANTS IN CHINA

Hankow has four electric-lighting companies. Their names, character of current, and supposed nationality are: Hankow Light & Power Company, alternating, British; Hankow Waterworks & Electric Light Company, direct, Chinese; Melchers & Company, alternating, German; Tai Shoh Electric Company, alternating, Japanese.

Information is not available regarding the number of meters used by the first-mentioned company. The Hankow Waterworks & Electric Light Company installed about 1700 meters and has under contemplation the installation of alternating current instead of direct. This firm would be pleased to receive information concerning meters, particularly for the new current. The meters used by this company are American and Ferranti.

OZONE FOR THE CHILDREN—IV. OR ENGINEERING TWISTERS RETOLD

After the recital of the last twister the old sea captain was so pleased that he invited me to a duck dinner. It was needless to say that all was most enjoyable, for there is no hospitality quite equal to that engendered by one who follows a life upon the sea.

I was somewhat disappointed, however, when only one duck appeared upon the platter so I decided to make the best of it.

"Captain," says I, "there are two ducks on that platter instead of one."

"No," said he, "there is but one duck."

"Well," says I, "I'll prove it."

I then proceeded as follows:

Let $x =$ number of ducks on platter or $x = d$, multiply both sides of the equation by d, we have

$$dx = d^2$$

Now subtract x^2 from both sides of the equation, which is perfectly allowable in mathematical science. Thus

$$dx - x^2 = d^2 - x^2$$

Now factoring, I have

$$x(d - x) = (d - x)(d + x)$$

Correcting out the common factor $(d - x)$, we have

$$x = d + x$$

But $x = d$, or substituting

$$d = d + d$$

$$\text{or } d = 2d$$

$$\therefore 1 = 2,$$

which is to say there must be two ducks on the platter.

The old sea captain was breathless in astonishment. Silently however, he looked at me, then at the duck, and jabbing his fork into its body, he slid the fowl on to his private plate and quietly said:

"Now, professor, you can have the other duck."

COMMERCIAL AND ENGINEERING TRAVELERS IN LATIN AMERICA

There has been a large demand for the monograph recently published by the Bureau of Foreign and Domestic Commerce which gives in detail the regulations with which commercial travelers visiting the Latin American countries must comply and contains general information of value to those undertaking to introduce American goods into these countries. The material in this publication was furnished by American consular officers in each of the Republics of Central and South America and covers such important subjects as license fees and the way of legitimately avoiding them in certain countries, documents with which travelers should be furnished, custom house requirements affecting travelers' samples and advertising matter, buying seasons, hotel and other expenses, etc. The price of this publication, which is known as Commercial Travelers in Latin America (Tariff Series, No. 35), is 10 cents, and copies may be purchased from the Superintendent of Documents, Washington, D. C., or from any of the district officers of the Bureau of Foreign and Domestic Commerce.

PHOTOGRAPHY FOR THE ENGINEER

BY C. B. MERRICK

(Photography continues to play an important role in the life of the engineer. Few, however, have the time to give to it that is necessary for mastering essential details. In a series of four articles, the author, who is with the Pacific Gas & Electric Company, and who has made photography a pastime, will set forth tabulated snappy points that should be placed in the notebook of the engineer for quick reference in case of camera utilization.—The Editor.)

San Francisco Bay From Tower of Jewels

THE applications of photography to engineering are so many and varied that it is often necessary to take pictures under extremely adverse conditions. The most satisfactory and certain way of obtaining good results at such times is to use an exposure meter, but due to the wide range of exposure which will satisfactorily expose a plate or film, it is possible to make good pictures by estimating the amount of light falling upon the object to be photographed.

Most failures are caused by not making sufficient allowance for varying intensities of light. The great allowance necessary is illustrated by the accompanying photographs, which with one exception, were all taken on bright summer days. Fig. 1 has the shortest exposure of the set. Fig. 2 had twice the equivalent exposure of No. 1. Fig. 3 had four times and the night scene in Fig. 4 had thirty thousand times that of No. 1.

The exposure necessary is influenced by the characteristics of the object to be photographed, by the intensity of the direct light upon it, and the reflected light from its surroundings, as well as by the distance from the camera.

Thirty Thousand Times the Light for Night Scene as Compared With Day Scene

As an example Fig. 1 was taken at 2 p. m. on a bright day in March. The subject was a distant bay scene with the sun shining directly upon it, the reflected light was strong, due to the broad open view, thus requiring a short exposure. Fig. 2 was taken directly against the sun. This was possible by shading the lens from the sun's direct rays and giving a longer exposure since most of the view was in the shade. Fig. 3 was brilliantly illuminated by the direct light of the sun, but the reflected light was very considerably reduced. The exposure was necessarily lengthened.

The Golden Gate Against the Sun

So many factors are to be considered in estimating exposures that each one should be judged separately, and then the result of the combination will be as close as it can be estimated.

Because he makes too little allowance for variations in intensity of illumination, the beginner usually over-exposes distant landscapes, sea and sky views, while shaded and indoor views are under-exposed. Since more views are taken near at hand, and since under-exposure is a more serious fault than over-exposure, more failures result from under-exposure. Fundamental rules to be remembered are:

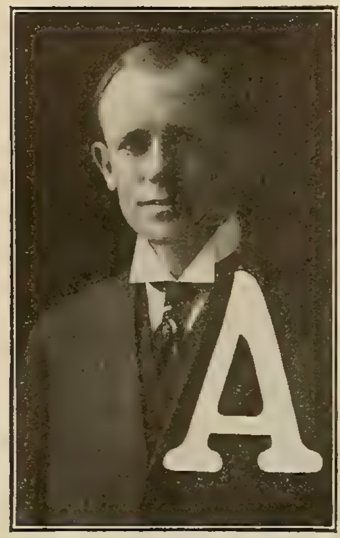
1. Give ample exposure.
2. Expose for shadows and let the high lights take care of themselves.
3. Exposure varies inversely with the distance from the camera.
4. Consider photo colors as well as eye colors.
5. Winter views require twice the exposure of summer views.
6. Use slowest shutter speed which will stop motion of objects in view.
7. Use a tripod for exposures longer than 1-25 second.
8. Shield the lens from direct sunshine.

The factors which control each exposure are classified as follows:

1. Characteristics of the object.
3. Type of day (weather).
2. Time of day (including direction of light).
4. Time of year.
5. Distance from camera.

THE PUTTING IN OF THE WISE POWER PLANT

(New records in physical proportion and in efficiency of design are constantly being established in hydroelectric practice in the West. Here is an account of the putting into service of a remarkable new power plant of the Pacific Gas & Electric Company, which owns the largest high tension distribution system in the world. The Wise plant, commemorating the youth of the West in its dedication to the memory of one of her most distinguished young engineers, presents to the hydroelectric fraternity a new record in size of turbine unit.—The Editor.)

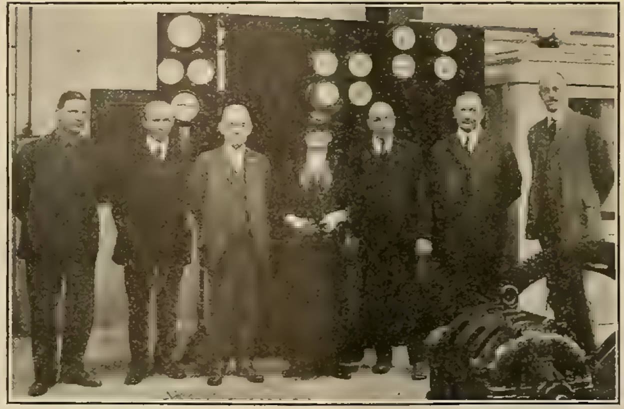


The Late James Hugh Wise

As Mrs. Clara Wise, mother of the brilliant young engineer, the late James Hugh Wise, threw in the switch that started the pumping of energy into the world's greatest long distance transmission net work some one remarked: "How fitting it is that a beautiful creation such as this new plant, which contains the largest single discharge turbine unit ever built in the history of engineering, should be named in memory of this young man."

And indeed the ceaseless generation of energy that will continue throughout endless time without diminution in its eternal source is symbolic of the energy of youth commemorated in the naming of this new creation of the Pacific Gas & Electric Company's system of hydroelectric development.

The new single discharge turbine is of 20,000 h.p. capacity and generates an additional 16,750 h.p. of electrical energy, making a grand total of nearly a quarter of a million horsepower of installed capacity in steam and electric generation for this system, which now supplies two-thirds the people of California with electrical energy and comprises the largest high tension distribution network thus far created in the art of electrical distribution.



THE CEREMONY AT THE SWITCHBOARD

W. C. J. Finely, J. P. Jollyman, John A. Britton, Mrs. Clara Wise, Jim Martin, P. M. Downing, and F. G. Baum.

The ceremony was simple, yet most impressive. Mrs. Wise, ably assisted by John A. Britton, the veteran head of the Pacific Gas & Electric Company, together with F. G. Baum, chief construction engineer, and P. M. Downing, chief engineer in the hydroelectric department, threw the switch shortly after one o'clock, on Sunday afternoon, March 4, 1917, and the Wise Plant beautifully responded to its summons without a shock or complaint and from now on will be an indissoluble unit in this remarkable system of hydroelectric generation in California.

A description of the physical features of this remarkable installation appeared in the columns of the Journal in the issues of September 30, 1916, and October 21, 1916. For the sake of completeness a resume of the unusual characteristics of this power plant will now be made.

The water from the new Halsey plant some seven and one-half miles above, after passing through a regulating pond, is conveyed through canals, tunnels and storage dams, finally to be dropped through the penstock pipe a vertical distance of 519 ft. into the Wise Power Plant.

Practically every type of conduit is used in one place or another in the construction of the canal. For instance, at one point open ditch is followed by semicircular steel fluming which later serves a masonry lined run of canal. At another point, the water passes from a forebay into wood stave piping, then through two pressure tunnels—concrete lined—again emerging into wood stave piping which finally serves the heavy steel riveted penstock piping that delivers the water to the giant Francis type of turbine in the power house below.

The generator unit is of 12,500 kw. capacity of the Westinghouse design. The turbine is of the Pelton-Doble design and is the one exhibited by the Pelton Water Wheel Company at the Panama-Pacific International Exposition in San Francisco.

The engineering considerations that led to the adoption of this giant turbine are interesting. The generator speed being fixed at 360 r.p.m. and the available head at 510 ft., a single nozzle, tangential wheel, having a specific speed of 5, would develop 100 h.p. To develop 20,000 h.p. the predetermined size of unit would require 20 jets, a combination impracticable under operating conditions. On the other hand, a turbine with a specific speed of 20 would develop 18,000 h.p. and 360 r.p.m. under a head of 500 ft. These limitations indicated a reaction turbine as the most suitable type of water wheel.

The Wise Power Plant is one of six that ultimately will constitute what is known as the Lake Spaulding development. Three of these plants are now in operation. The time for constructing the others has not been set.

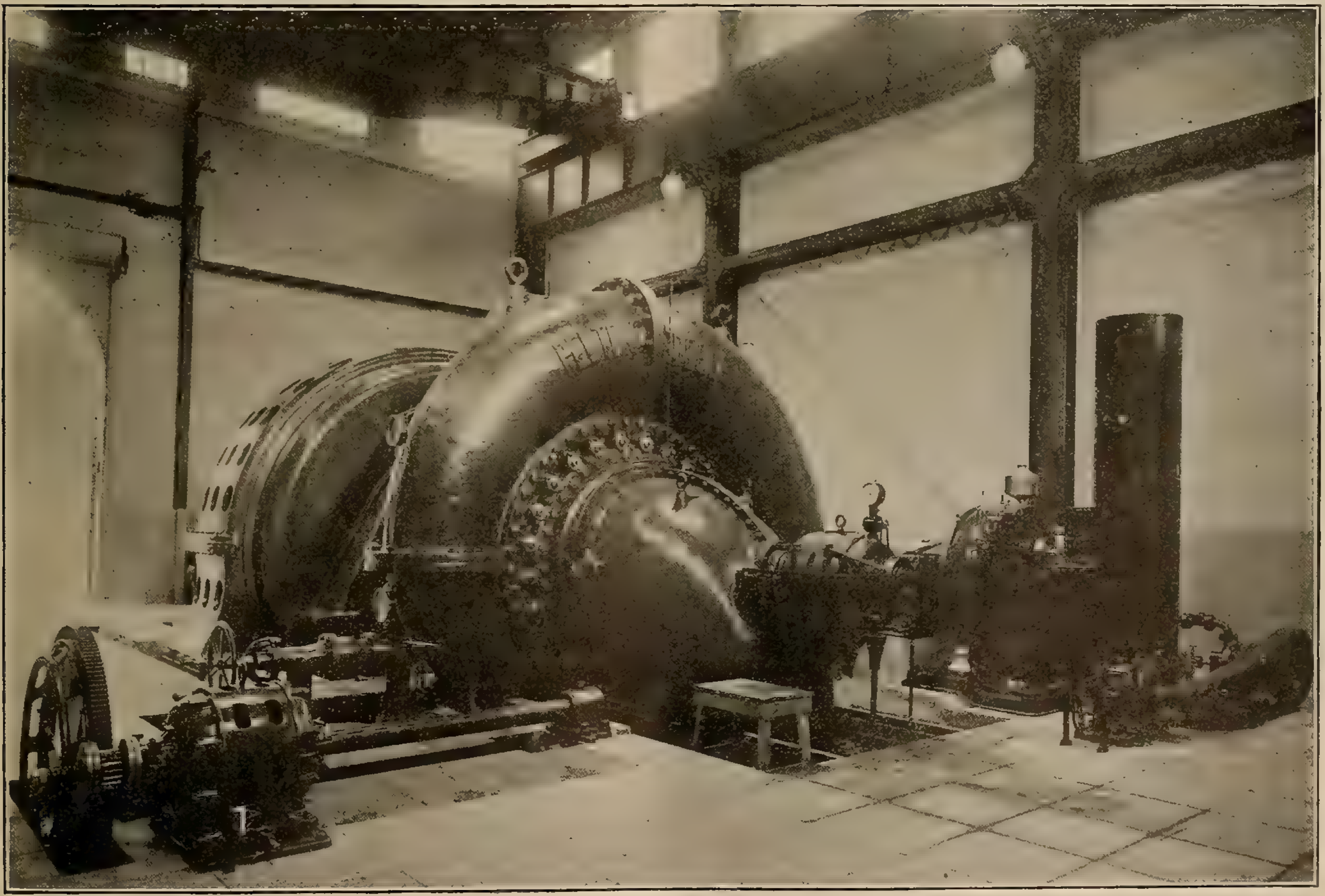
A tunnel has been driven through the almost per-

Officials and Prominent Engineers at the Intake of the Penstock of the Wise Power Plant

pendicular granite wall at the Spaulding dam, whereby its reservoired waters are started on their journey. After passing through the Drum and Halsey power houses, these waters finally drive the turbine at the Wise plant. The total potential power development of the entire system is 6000 kw. at the Spaulding, 50,000 kw. at the Drum, 25,000 kw. at No. 2, 15,000 kw. at the Halsey, 12,500 kw. at the Wise, and 15,000 kw. at No. 5, making a grand total of 123,500 kw.

The exterior of the power house represents the last word in artistic design. It is arranged so that it can be flood-lighted at night and will serve as a remarkable monument of publicity for the company in that the Lincoln Highway and the transcontinental lines of the Southern Pacific Company pass within easy vision of the location of the power house.

As a whole the completion of this project represents not only a triumph in engineering for those having the work in hand, but a distinct advance in the art of hydroelectric generation.



Interior View, showing Generator and Turbine, the latter being the Largest Single Discharge Unit in Existence

MERCHANDISING ELECTRICAL ENERGY

(To successfully merchandise electrical energy, the commercial engineer must so plan his campaign that he not only sees to it that his client purchases the necessary current consuming apparatus but above all he must see to it that the sale is a proper one from the standpoint of economy to the purchaser. Here is a valuable contribution on how to check up on the machinery salesman that should immensely forward permanency and satisfaction among clients of the power company. The author is commercial engineer for the Southern Sierra Power Company of Riverside, Cal.—The Editor.)

CHECKING UP ON THE MACHINERY SALESMAN

BY ROSS B. MATEER

Due, not only to the climate, but to the extensive advertising campaign of California lands, prosperous farmers of the Middle West States are acquiring ownership to extensive acreage of unimproved lands with the avowed purpose of growing profitable crops. At first grain is experimented with in an attempt to dry farm, then wells are sunk and the ground turned over for the seeding of alfalfa. A fair stand is obtained before the close of the first year and as the price per ton of alfalfa increases, visions of unincumbered lands and a fair bank account seem fair to be realized until a scarcity of water is experienced for the adequate irrigation of the acreage under cultivation or the crude method of delivering the water to the soil and arising from improper preparation of the land results in an apparently high cost per inch of water pumped. Confronted with an apparent deficit, the rancher is apt to ascribe his failure to the power used to operate his plant rather than to the character of the pumping equipment and its adaptability to his demands for water or to his oversight in attempting to apply to the growing of California crops methods pursued in states subject to different climatic and soil conditions. It is at this time the rancher is most in need of assitance and to whom can he turn with the assurance of receiving trustworthy information other than to the field agent of a quasi public utility, bent on upbuilding a territory with aggressive intelligent agriculturists.

The power used may be the "barking dog" whose sustenance is fuel oil and though a good supply may be on hand, yet ignorance of the engine and its operation results in a heavy expense, (1) through the forced employment of an experienced operator and (2) the replacement of parts damaged by changes in fuel, engine installation, alignment, etc. Not every rancher is a mechanic and as expensive farm implements are permitted to remain, when not in use, out in the open and subject to all conditions of weather and in various stages of repair, so may internal combustion engines be a source of dissatisfaction to the average rancher as is illustrated by recent correspondence with a supply branch:

"Apple Valley, Aug. 11, 1916.

"Gents:—The gas engine you sent me stops when theres nothing the matter with it thats the trouble. it wouldn't bee so bad if it stopped for some reason and anybody knows theres reasons enough for it to stop. and why cant it pick out one of them reasons for stopping instead of stopping for no reason at all so that no one cant find the reason because you cant find a reason can you when there aint no reason thats common sense aint it.

"I received the book which you sent me which is named What Makes the Gasoline Engine Go. I aint read it yet because whats the use of reading it when I dont care what makes the gasoline engine go as long as it goes which mine dont only occasionally when not particularly needed but just when experimenting or something. what I want to know is What Makes the Gasoline Engine Stop. if you got a book called that send me one and thats what I want to know particularly what makes my gasoline engine stop when everything is o k and nothing is the matter except that it must be a rotten engine."

Again the equipment installed may be too large for the quantity of water developed in the well and the pump remains as a monument to the salesmanship of the machinery house's representative whose remuneration was a percentage of the sum invested in the engine and pump and whose interest in the customer and his welfare ceased upon the delivery of, the installation of and the payment for the pumping unit, contrary if you please to the progressive policy of the modern central station and whose interest in a consumer only begins after the installation of the plant and with the delivery of "juice." A well may deliver seventy-five inches of water without exceeding the suction limit, yet salesmen advocate or permit the farmer to install a pump with a capacity for one hundred twenty inches of water or more which error in the selection of equipment is glaringly evident in the operating cost.

Again why not use judgment in the choice of a pump with reference to the duty demanded of it. When a well is sunk and a pit has been dug and curbed why boost for a vertical belt-driven outfit with its frame, shaft and bearings, except where varying water levels are found, when a small direct connected motor operated centrifugal unit may be placed in the pit, just above the normal water level with a smaller initial investment and a lower operating expense. Or, if it is not desired to dig a pit why encourage the high speed turbine pump when the deep well plunger, positive acting unit may be installed for perhaps the same investment though with an increase in plant efficiency of from ten to twenty per cent—and with an operating economy equal to perhaps the total fixed charges on the investment,—interest, depreciation, insurance etc.

Problems as above cited confront the conscientious representative of a public utility almost daily and the only solution is education, not alone of the rancher but of the machinery salesman. The one to purchase and the other to sell only such apparatus as will operate without attendance or many repairs and at a minimum expense per hour of service. Only recently a representative of a reliable manufacturing company

when requested to quote on a turbine pump for service in connection with a fourteen inch well and with a lift of one hundred twenty-five feet, frankly referred the inquiry to a firm building and installing deep well plunger heads, earning the good will of both customer and central station.

Exemplary of the assertion as to the over-rating of the original installation were the engines and pumps recently displaced with electrically driven units in the vicinity of Winchester, California. Here as a result of a thorough investigation of the water conditions, the capacity of the engine driven units and the demand for water one hundred and thirteen horsepower in gas-oil operated engines were displaced with seventy-five horsepower in General Electric polyphase motors and Byron-Jackson pumps of suitable capacity for the wells. Consideration of the acreage to be irrigated and the crops grown further convinced the consumer that for several years, only three of the new electrically driven plants would be required for the

Plant No	H.P. of Engine	Gals. of Fuel Used per Hour	B.H.P. at Pulley on basis of lift per h.p. per hr	Size of Cent. Pump now Installed	Normal Capacity of Pump	Estimated Amount now Pumping on Average
Plant No. 1	18	1¼	10	No. 5	45 in.	30 in. to 40 in.
Plant No. 2	25	2	16	No. 6	70 in.	40 in. to 50 in.
Plant No. 3	25	2½	20	No. 8	175 in.	50 in. to 60 in.
Plant No .4	35	3½	28	No. 8.	175 in.	90in. to 100 in.

thorough watering of his soil, permitting the fourth plant to remain as a reserve unit. A recapitulation of a portion of the report may be of interest.

Plant No.	Dist. of Water from Surface	Dist of. Pump from Surface	Vacuum in Feet when Pumping	Lift Above Surface	Total Feet
Plant No. 1	4	10 ft.	27	4	41 ft.
Plant No. 2	4	10 ft.	27	4	41 ft.
Plant No. 3	6	10 ft.	27	4	41 ft
Plant No. 4	4	10 ft.	27	4	41 ft.

PlantNo	Estimated H.P. Required to Operate Present Pump	H.P. of Motor Recommended	Size of Pump.	Capacity.	E.H.P.	K.W.	Horsepower Input by Test
Plant No 1	10	10	No. 4	40 in.	9.3	6.9	6.15
Plant No. 2	16	15	No. 4	50 in.	13.7	10.2	9.87
Plant No. 3	20	15	No. 5	60 in.	14.9	11.1	12.85
Plant No. 4	28	25	No. 6	100 in.	22.4	16.7	

Plants one, two and three with a combined horsepower input at the meter of twenty-eight and eighty-seven (28.87) in continuous operation for two thousand three hundred forty-eight (2348) hours and an expense of four hundred nine dollars ($409.00) were supplied with service at a fixed or flat charge per horsepower of maximum demand per season.

To provide for increased head when irrigating and for the conservation of water a large earthen basin seventy-five (75) by ten (10) ft, has recently been completed. This basin will store all the water pumped throughout the night eliminating the rather unsatisfactory flooding of the ground by "lamp light.'

RESUSCITATION FROM ELECTRIC SHOCK

FIG. 1—INSPIRATION; PRESSURE OFF.

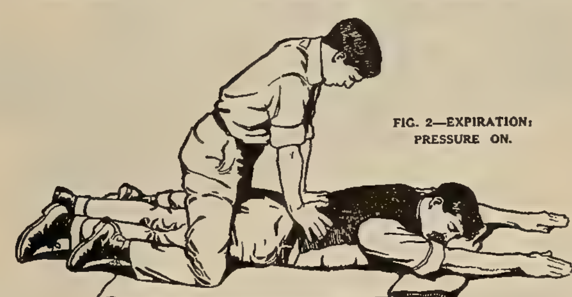


FIG. 2—EXPIRATION; PRESSURE ON.

FOLLOW THESE INSTRUCTIONS EVEN IF VICTIM APPEARS DEAD

I. IMMEDIATELY BREAK THE CIRCUIT

With a single quick motion free the victim from the current. Use any **dry non-conductor** (clothing, rope, board), to move either the victim or the wire. Beware of using metal or any moist material. While freeing the victim from the live conductor have every effort also made to shut off the current quickly.

II. INSTANTLY ATTEND TO THE VICTIM'S BREATHING

1. As soon as the victim is clear of the conductor, rapidly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth, etc.). Then **begin artificial respiration at once.** Do not stop to loosen the victim's clothing now; **every moment of delay is serious.** Proceed as follows:

(a) Lay the subject on his belly, with arms extended as straight forward as possible, and with face to one side, so that nose and mouth are free for breathing (see Fig. 1). Let an assistant draw forward the subject's tongue.

(b) Kneel straddling the subject's thighs and facing his head; rest the palms of your hands on the loins (on the muscles of the small of the back), with fingers spread over the lowest ribs, as in Fig. 1.

(c) With arms held straight, swing forward slowly so that the weight of your body is gradually, but **not violently,** brought to bear upon the subject (see Fig. 2). This act should take from two to three seconds.

(d) Then immediately swing backward so as to remove the pressure, thus returning to the position shown in Fig. 1.

(e) Repeat deliberately twelve to fifteen times a minute the swinging forward and back—a complete respiration in four or five seconds.

(f) As soon as this artificial respiration has been started, and while it is being continued, an assistant should loosen any tight clothing about the subject's neck, chest, or waist.

2. Continue the artificial respiration (if necessary, two hours or longer), **without interruption,** until natural breathing is restored. If natural breathing stops after being restored, use artificial respiration again.

3. **Do not give any liquid by mouth until the subject is fully conscious.**

4. Give the subject fresh air, but keep him warm.

The prone-pressure method of artificial respiration described in the rules (Section II), is equally applicable, after clearing the mouth and throat of froth, to the resuscitation of the apparently drowned, and also to cases of suspended respiration due to inhalation of gas or other causes. —*Reproduced by permission of the National Electric Light Association.*

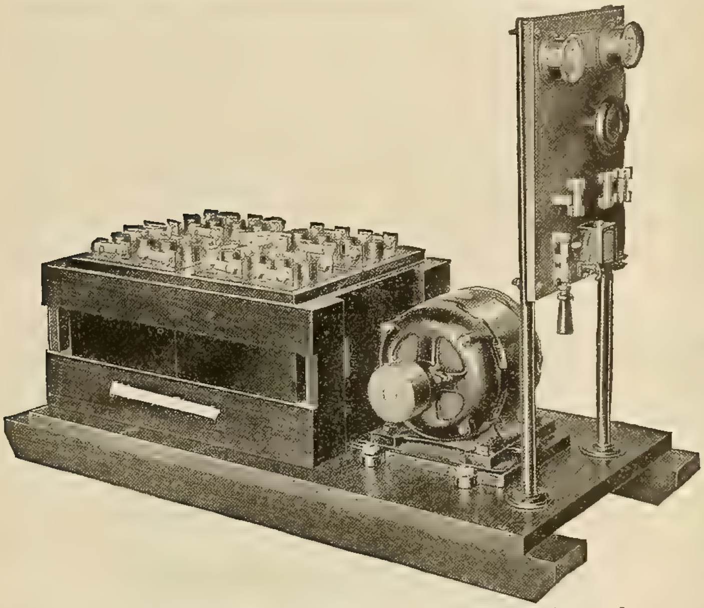
SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER

(Few realize the immense field of profit open to the contractor and dealer in the way of electrical farm specialties and appliances. Here is a valuable discussion on farm lighting plants followed by "up-to-the-minute" briefs on a remedy for damaged pressure switches, power required to drive generators, and the size of wire for flood-lighting projectors. The author, who is a power apparatus specialist, is with a prominent electrical supply house in San Francisco.—The Editor.)

FARM LIGHTING PLANTS—THE GOLDEN OPPORTUNITY FOR THE ELECTRICAL CONTRACTOR

It was our distinct pleasure recently to be in the advertising department of one of the country's largest electrical manufacturers. While there, we saw in one day's mail hundreds of letters asking for a certain electrical hand book that is being distributed to farmers on request. Each one of these requests represents a potential buyer of a small lighting plant for farm use. Each potential buyer of a small lighting plant represents a most fertile field for the electrical contractor.



Typical Farm Lighting Plant, showing Generator and Switchboard Mounted On Skids

For years the electrical contractor has had his business limited by certain defined lines. Wherever electrical service was rendered by a central station there was opportunity for the electrical contractor—houses could be wired and appliances sold. But the territory beyond that covered by the central station was arid as far as electrical work was concerned. Where there is no electricity there is no sale for electrical appliances—no electrical contracts to be bid for.

But now the advent of the perfected electric lighting plant for the farmer opens up a vast new field for the contractor. As a matter of fact, it breaks down all trade barriers and makes the country an open market for the electrical contractor. The contractor who has the agency for farm lighting plants can, first of all, sell the plant; he can then install it, which, of course, means the wiring of the house, barn and outbuildings; second, he can sell sockets, fixtures and switches; third, he can equip the farm with socket appliances, such as vacuum cleaners, washing machines, irons, etc. Each distinct step entails a profit and represents a business that is worth the efforts of the most progressive merchandising man.

Never in the history of the country has the farmer element been as prosperous as it is today. One of the greatest fields for the automobile industry is the farmer, and one of the greatest fields for the electrical contractor will be the farmer. If any electrical contractor will make a survey of the number of farmers surrounding him, and if he will consider each one a potential buyer of a lighting plant, and if he will further consider each one as a buyer of socket appliances, he will realize that a gold mine lies at his feet.

The large manufacturers responsible for the development of the farm lighting plant are spending enormous sums for advertising these small electric lighting plants—their advertising reaching every farmer in the country. An elaborate electrical hand book has been made up and written especially for the farmer, and is being distributed to the four corners of the country by the thousands. Publicity of this sort cannot help but show returns, and the number of farm lighting plants that are being sold daily attest to the value and effectiveness of this publicity.

It is the wise contractor who gets in early on this farm lighting plant proposition and secures the exclusive agency in his territory for its sale. It is a virgin field, representing a bonanza for the contractor who is looking for business and plenty of it.

A REMEDY FOR DAMAGED PRESSURE SWITCHES

There are a number of diaphragm pressure or regulator switches on the market. While these are designed primarily for use as pilot switches with self starters, a number of them have contacts large enough to handle the current of small motors which can be started by being thrown directly across the line. The limit of capacity of such switches is about 3 h.p. at 110 volts or 5 h.p. at 220 volts, for either single or polyphase circuits.

Quite often, however, these switches are selected to control motors somewhat larger than their rated capacity, the idea being to effect a saving in the first cost of the controlling apparatus. For example, it is not uncommon to find switches rated 3 h.p. at 110 volts in use with 5 h.p. motors of the same voltage. When overloaded in this manner the contacts are very likely to give trouble in a short time, especially if the service is severe, requiring a large number of operations per day. Under these conditions, if the contacts become burned or damaged it rarely pays to repair or replace them because the trouble will invariably occur again unless the load on the switch is reduced. In other

words, such repairs would really be only temporary, at least this has been the writer's experience.

The proper way to remedy such troubles is, of course, to provide some form of self-starter, allowing the pressure switch to handle only the current required by the pilot or control circuit of the starter. If the contacts are not too badly burned, it may not be necessary to replace them when adding the self-starter, because only a small current is required to operate such devices. But the burned parts should be carefully cleaned and readjusted to make the best possible contact. If the switches are double-pole, it is well to connect both sides in parallel, thus making a single-pole switch of double the carrying capacity, since only single-pole switches are required for pilot circuits.

POWER REQUIRED TO DRIVE GENERATORS

A "rule of the thumb" method of determining the power required to drive a direct-current generator at full-load is to allow 1.6 horsepower per kilowatt of generator capacity. Thus, a 10 kilowatt generator at full load would require 16 horsepower at its driving pulley or shaft. This factor is based on an efficiency of 82 per cent at full load and is a fair average value for direct-current belted generators in sizes up to about 75 kilowatts. It is figured in this way. One kilowatt or one thousand watts output at an efficiency of 82 per cent requires an input of

$\frac{1000}{.82} = 1220$ watts, which is practically 1.6 horsepower since there are 746 watts per horsepower.

By averaging the efficiencies of the different sizes more carefully and then carrying out the same calculations just shown we can arrive at three factors which will be sufficiently accurate for all practical purposes and at the same time take into consideration the increase in efficiency which occurs in the larger sizes. These are given in the following tabulation:

Rating of Generator	Average Full Load Efficiency	Watts Input per Kw. Output	H.P. Input per Kw. Output	Factor
Less than 2 kw.	75%	1333	1.79	1.8
3 to 20 kw......	82%	1220	1.64	1.6
20 to 75 kw.....	86%	1163	1.51	1.5

These factors do not take into consideration the overload capacity of the generator although most types of machines, as now rated, will carry 25 per cent overload for two hours without excessive heating. If it is desired to take advantage of this overload capacity the horsepower required to drive at full load, as estimated by using any of the above factors, should be increased by 25 per cent. Thus, a 15 kilowatt generator operated at this overload will require $15 \times 1.6 \times 1.25 = 30$ h.p.

When generators are driven by motors it is not necessary to allow for this overload capacity, as motors are rated to carry the same percentage of overload as generators. Therefore, a motor large enough to operate a machine at its full load will also be large enough to drive it at any overload it may safely carry. However, when gasoline or steam engines are to be used their overload capacities should always be ascertained as most of them are closely rated and will not stand as much overload as the ordinary generator. Again it must be remembered that the rating of a gasoline engine is affected by the altitude at which it is operated, the output decreasing as the altitude increases.

These calculations are extremely simple and elementary but are explained in detail because such questions are brought up so frequently in connection with small generator installations.

SIZE OF WIRE FOR FLOOD-LIGHTING PROJECTORS

Satisfactory results from flood-lighting projectors should not be expected unless the lamps in them are burned at practically their rated voltage. This is true of any Mazda lamp but the manufacturers of projectors have been particular in emphasizing this point because there is more likelihood of these lamps being used on circuits of excessive voltage drop.

The correctness of this reasoning will be apparent if it is remembered that these projectors are frequently used at a considerable distance from the service mains, for instance as they would be when placed on the top of a building to illuminate a sign or tank or for similar service. Again many of these projectors are used on rush construction jobs where large areas are to be lighted. The wiring is generally only temporary and often any wire at hand is put into service without regard to its size. Then the circuits are frequently lengthened as work progresses and the splices poorly made, all of which are favorable to large voltage drop. The maximum drop in any case should not be over 2 per cent and preferably less.

The proper size wire for these lamps can be easily selected from the accompanying table which gives the length of the circuit one way in feet for a drop of 2 volts which is equal to almost 2 per cent of the delivered voltage assuming 115 volts at the lamp terminals. Note carefully that the length of the circuit means the total distance between the lamp terminals and the service mains and not the total length of wire in the circuit. In a two-wire circuit the total length of wire would of course, be twice the distance in the table.

By remembering that the voltage drop is proportionate to the length and wattage of the circuit this table can be used for leads supplying a number of lamps or for circuits of greater lengths. Also for other lighting circuits or to check the approximate voltage drop in a given circuit.

The three sizes marked with an asterisk are the new ratings which have just been standardized for projector service.

Wiring Table for Two Volts Drop—Lamp Voltage 115

Wattage of Lamp or Load	Size of Wire—B. and S. Gauge No. 14	No. 12	No. 10	No. 8	No. 6	No. 4
200*	232	368	586	934	1484	2360
300	155	246	392	622	990	1572
400*	116	184	294	374	742	1178
500	92	148	234	374	594	944
750	62	98	156	248	396	628
1000*	46	74	116	186	296	472

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(The distribution of water in irrigation pumping is a detail little thought of and yet statistics show that herein are brought about the greatest losses in the conveyance of water from the underground source to its place of application. Herein the author sets forth a discussion of the best methods that should be employed in its distribution.—The Editor.)

Pressure Stand for Walnuts

Small Pressure Stand for Oranges

Pressure Stand in Operation

DISTRIBUTION OF WATER TO FURROWS

The furrow method of irrigation is extensively used in irrigation pumping practice. This is due to the fact that crops of relatively high value are required under the higher lifts and these crops are generally orchards or row crops which are adapted to furrow irrigation. The size of irrigation stream secured from many plants is also too small for effective use in flooding but may be suitable for furrow irrigation. With furrow irrigation equal efficiency in the use of the water can be obtained with very small heads by varying the number of furrows run at a time in proportion to the supply. The best labor efficiency in application is of course obtained with supplies sufficiently large to fully occupy an irrigator.

The first essential in furrow irrigation is some means of controlling the flow into each furrow. If efficient use of the water received is to be made it must be divided between the different furrows in proportion to the needs of the soil to be irrigated from each furrow. This need is generally uniform per furrow, and the water is divided equally among all the furrows in use. In some cases, such as on irregular areas or where furrows next to the trees in orchards are zig-zagged more water may be intentionally turned into some furrows than into others.

The stream used per furrow naturally varies rather widely. For potatoes, where the furrows are relatively large, more than 2 miners' inches per furrow or 25 or less furrows per second foot may be used. In furrow irrigation of grain and alfalfa as practiced in some localities on steep and heavy soil a second foot may supply 150 furrows. In usual orchard practice the supply per furrow does not often exceed 1 miners' inch or 50 furrows per second foot and frequently not over one-half this amount or even less will be used. The division of a stream into these small parts requires some fairly complete method of control if satisfactory results are to be obtained.

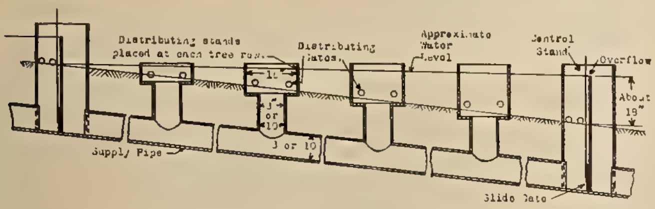
The methods used in distributing water to furrows vary with the crop and the value of the water. Where water is plentiful and the crops temporary, simple shovel cuts in the banks of the field ditches may be made for each irrigation. Where water is expensive and the crop permanent and of high value, the stream used may be distributed through concrete pipe systems in which it is under practically complete control and can be very closely divided.

The crudest methods are those where earth ditches are used. In general irrigated farming where crop rotation is practical each field may be in crops which are irrigated by furrows for only one or two years out of each five to eight years. The other crops grown are generally flooded so that the cheaper and more temporary methods of distribution to furrows are used. The field ditches used for the flooded crops if permanent may also be used for the furrow crops.

Instead of taking each furrow directly from the supply ditch, one cut in the ditch bank may be used to supply 5 to 10 furrows by means of short ditches or sets. This gives a double regulation, the cuts in the banks of the supply ditch being made of sufficient size to supply the set and this flow again divided among each of the group of furrows. The disadvantages of this cutting of the banks are the lack of uniformity in the flow in the furrows resulting in waste from some and probably an insufficient supply in others and the larger amount of labor required during irrigation. The flow in each furrow is regulated by enlarging the cuts when an increase in flow is desired and in closing with earth, hay, manure or grass when the flow is to be reduced. In one experiment carried out on sugar beets in Colorado by the U. S. Department of Agriculture, the yield on one tract irrigated by this method was lower by 15 per cent than that on an adjoining plat to which the flow was controlled by lath boxes in the banks.

The next method used consists of placing lath boxes or other tubes through the banks of the supply ditch. All such tubes above any given ditch check should be placed at the same elevation. This gives uniform flow through the crop with less waste. It is frequently used for areas which are to be irrigated by furrows for 2 years or over. The cost of such boxes is not usually warranted by the saving that could be made in a single year's use.

What are known as irrigation lath, ½ × 2 × 3 ft. are generally used. Four of these lath give an opening of about 2 square inches and when set about 4 in. below the water surface will give a flow of about 1/25 of a second foot. The cost is about 6.5 cents each in place. Second hand pipe up to 3 in. in diameter may be used when obtainable. Galvanized tubes for this purpose are also handled by some of the irrigation supply houses. The flow through the lath tubes is



Typical Overflow System

regulated by small blocks inserted in the tube or nailed to one corner and revolved to give the area desired. This method gives a much more uniform distribution of the water and requires less attention in irrigating than the use of earth cuts.

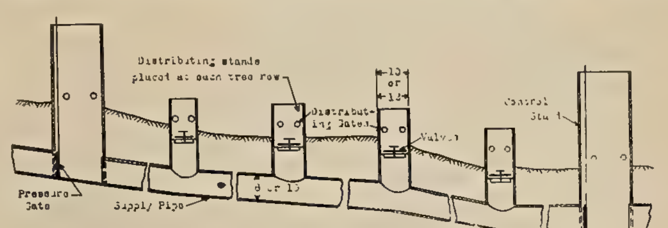
Where fields are to be irrigated by furrows for from 3 to 6 years wood flumes are frequently used. These have a useful life sufficiently long for such purposes. The flumes are usually made of 3 pieces 1x12 or occasionally 1x8, depending on the stream handled. Occasionally a two-board triangular flume is used. Diversion to the furrows is made by boring holes in the side at the bottom. These holes vary from ½ to 2 in., depending on the stream to be run in the furrow. When not in use they may be closed with wood plugs of the same diameter as the hole or small galvanized spout gates may be used, similar to those used with concrete pipe. Such flumes are in general use in garden and truck irrigation. For permanent furrow systems such as those used in the irrigation of orchards, concrete pipe distributing systems are used where the value of water is high. This condition occurs generally in Southern California. The longer season and greater number of irrigations given citrus fruits also makes economical methods more profitable than they would be for localities having shorter crop seasons. Concrete flumes have been used for similar conditions. The use of such flumes preceded the use of pipe and many flume installations are still used in the older localities as around Riverside. It is probable that at present over 90 per cent of the new installations are concrete pipes in preference to concrete flumes. The difference in cost for the sizes of pipe generally used is small and the greater convenience in cultivation and other factors make the pipe preferable. Distribution from concrete flumes is made through openings in the side similar to those used with wood flumes.

Where concrete pipe is used, there are two general methods of distributing water to the furrows. In both methods a concrete stand is used, generally placed at each tree row. In the overflow system these stands are arranged so that the water will rise in each stand of the series to approximately the same height, the control of the flow to the furrows being secured entirely through the small slide gates or spouts. In the other method known as the pressure system each stand contains a valve which controls the flow from the supply pipe into the stand. In both methods check or control stands are used at intervals.

In the overflow system, the control stands are placed at differences of elevation of about 18 in. Where the land slopes more than 18 in. or 2 ft. per 100 ft., this brings such overflow stands too closely together and the pressure system is preferable. The overflow or spillway is located so that the water will be checked back in the delivery stands above to the desired height above the distributing gates. The flow into each furrow is then controlled by the distributing gates or slides.

In the pressure system, control stands need only be placed sufficiently near together that the pressure will not exceed that to which it is desired to subject the pipe or for convenience in operation. The opening of the valve is adjusted to the pressure at each stand so that the water in the stands rises to about the same height above the distributing gates or spouts. When the valves have once been regulated little additional attention in irrigation may be required. In the control stands a pressure gate placed on the upstream side may be used as shown in Fig. 1 or a simple slide gate may be used, set over the end of the outlet pipe. For the latter case the stand must be given a height greater than the pressure head in the pipe. This may require heights of stand of over 6 ft. in many cases. For such conditions pressure gates are preferable.

A number of types of stands and gates are found in practice. Instead of using the two sizes of pipe in the overflow system as shown in Fig. 1, a single size, usually 10 or 12 in. in diam-



Typical Pressure System

eter may be used. For pressure stands, the valve may be omitted and each stand capped, the control of the flow being secured entirely through the distributing gates or spouts. For such stands the spout gates are placed on the outside of the stand which requires heavier gates if leakage is to be prevented.

Present practice tends toward the use of the pressure system which stands as shown in the figure. This is due to the fact that much of the land now being planted is in the foothills or on slopes too steep for the overflow system. The pressure system is, however, being installed in many locations which are suited to either method. The distributing stands are more generally of the type shown in Fig. 1, when only 4 furrows are to be used, a typical practice. In soils which wash or where there are more than 4 furrows per stand the larger topped stands are used so that the distributing gates can be placed further apart and cross washing of the furrows prevented.

WESTERN ELECTRICAL ASSOCIATION MEETINGS

(The Pacific Coast Section of the National Electric Light Association is fast rounding into convention form. This gathering which is to be held at Riverside in April is creating interest to a marked degree throughout all sections of the territory involved. Below will be found many interesting and important details concerning the progress of the work now being carried on by the various section committees, followed by a complete list of Class A members.—The Editor.)

PACIFIC COAST SECTION CONVENTION AN ASSURED SUCCESS

The first annual convention of the Pacific Coast Section of the National Electric Light Association will be held at Riverside, California, April 19, 20 and 21. Riverside is half way between eastern New Mexico and northern California, conveniently reached from every town in the section and a point of great electrical and scenic interest.

A. B. West, vice-president of the Southern Sierra Power Company, who extended the invitation to meet at Riverside, has been appointed chairman of the convention committee, and with his associates has worked out a complete program of entertainment for the visitors.

Each of the standing committees has prepared a fine program of papers and reports, which will occupy every minute of the two days' business session and the general officers of the section have been enthusiastically at work to assure the general success of the meeting.

Plans are being made to care for at least two hundred electrical men from New Mexico, Arizona, Nevada and California. Each man is expected to bring his wife and family, if so fortunate, with the assurance that every provision has been made for the comfort and entertainment of the ladies.

The following program has been tentatively arranged:

Thursday, April 19th

8 to 10:30 a. m. Registration and reception of members.

10:30 a. m. Section called to order by president. Address of welcome by mayor and president of chamber of commerce; Response by John A. Britton. President's address. Reports from secretary and treasurer. Announcements.

2 to 5 p. m. Business session for members. Reception and card tournament for ladies. Organ recital in Cloister Glennwood Inn.

8 p. m. Address on Southern Sierras Power Company's system by C. O. Poole, illustrated by lantern slides. Musical entertainment.

Friday, April 20th

10 to 12:30 a. m. Business session for members.

2 to 5 p. m. Business session for members.

2 to 3 p. m. Auto drive for ladies.

3 to 5 p. m. Garden tea for ladies at Edgemont.

7 p. m. Banquet at Glennwood Inn for members and ladies.

9:30 p. m. Report of Public Policy Committee.

Saturday, April 21

9 to 12 a. m. Auto ride via Scenic Road to Redlands, visit Smiley Heights, thence to San Bernardino and over the Rim of the World road to crest of San Bernardino Mountains.

12 to 2 p. m. Luncheon at Pine Crest, given by Southern Sierras Power Company.

2 to 4:30 p. m. Return to Riverside, stopping at Southern Sierras Power Company's steam plant at San Bernardino and Southern California Edison Company's substation at Colton.

8:30 p. m. Ball at Glennwood Inn.

Sunday, April 22nd.

Such auto trips and other inspection visits as visitors may desire.

Engineering Committee

During the past month Chairman J. E. Woodbridge has had numerous conferences with members of his committee and called all together in one general meeting. As a result it has been decided to submit reports at the convention dealing with several specific problems of Pacific Coast interest. A complete account of progress in the investigation of porcelain as an insulator, legislation on line construction, standardization of pole line material, inductive interference, the safety code, transformer standardization and oil engines comprise the main topics under consideration. S. J. Lisberger is chairman of the sub-committee on Transformer Standardization; L. M. Klauber on Standardization of Pole Line Material, and J. E. Woodbridge on Inductive Interference.

Commercial Committee Meeting

Chairman S. V. Walton called a meeting of the Commercial Committee at San Francisco, February 14th. After a general discussion is was decided to devote one entire day at the Riverside meeting to the consideration of commercial problems under five general headings: (1) rates, (2) merchandizing of current consuming devices, (3) cooking and heating, (4) industrial uses, (5) commercial organization. The rate report will center around a paper on "Rates" by W. G. Vincent, with special contributions on the subject of rates for irrigation service. The merchandizing report will discuss co-operative methods of central stations and dealers. The main part of the cooking and heating report will consist of a comprehensive account of electric water heating tests. The committee will recommend the immediate preparation of a booklet on "Irrigation" as the most important industrial use of electricity in the West. There will also be a report on "Organization and Conduct of a New Business Department." Special attention will also be devoted to "Highway Lighting."

H. A. Lemmon is chairman of the sub-committee on Rates, J. B. Black on Cooking and Heating, A. W.

Childs on Merchandizing, E. B. Criddle on Organization, A. E. Holloway on Industrial Uses and E. B. Walthall on Highway Lighting. The next meeting of the committee will be on March 16th at Los Angeles.

Accounting Committee

Chairman B. F. Story is arranging for a special report on accounting methods to conform with the requirements of Western public service commissions.

Membership Committee

Chairman W. W. Briggs and his fellow committeemen are actively at work on a membership campaign which will insure at least a thousand Class B members in the Section by the time of the Riverside convention. A convincing pamphlet on the benefits of N. E. L. A. membership has been prepared by the committee and special efforts are being put forth to get every electrical man in the four states into the association.

Convention Committee

On Feb. 21 Chairman A. B. West called a meeting of the committee on arrangements for the convention at Los Angeles. The committee agreed upon the program as printed herewith and various subcommittees were appointed with the following chairmen: Attendance, W. L. Frost; Transportation, E. B. Strong; Reception, E. B. Walthall; Publicity, Henry Bostwick; Finance and Auditing, D. M. Speed; Entertainment, A. B. West. The transporation sub-committee has arranged for a fare and one-third rate on all railways and is planning on at least one special car to the convention from San Francisco. The committee will meet at Los Angeles on March 17th.

CLASS "A" MEMBERS PACIFIC COAST SECTION NATIONAL ELECTRIC LIGHT ASSOCIATION

Arizona

Bisbee—Bisbee Improvement Co., C. S. Thompson, Manager.
Clarkdale—Upper Verdi Public Utilities Co., R. C. Lane, Mgr.
Douglass—Douglass Improvement Co., R. G. Arthur, Manager.
Flagstaff—Flagstaff Electric Light Co., G. T. Herrington, Mgr.
Globe—Globe Light & Power Co., W. S. Sultan, Manager.
Kingman—Desert Power & Water Co., F. A. Wilde, Jr., Mgr.
Mesa—Southside Gas & Electric Co., H. L. Chandler, Manager.
Miami—Miami El. Light, Tel. & Water Co., L. Van Dyke, Mgr.
Nogales—International Gas Co., S. S. Proto, President.
Nogales—Nogales Elec. Lt., Ice & Water Co., F. A. Faust, Supt.
Phoenix—Pacific Gas & Electric Co., H. L. Aller, Manager.
Prescott—Prescott Gas & Electric Co., M. V. Watson, Mgr.
Tucson—Tucson Gas, El. Lt. & Pwr. Co., F. G. Russell, Mgr.
Williams—Williams Water & Elec. Co., Luther Stover, Mgr.

California

Fresno—San Joaquin Light & Power Corp., A. G. Wishon, Mgr.
Hanford—H. G. Lacey Co.
Los Angeles—Los Angeles Gas & Elec. Co., Wm. Baurhyte, Vice-President.
Los Angeles—Pacific Light & Power Corp., G. C. Ward, V.-Pres.
Los Angeles—Southern Cal. Edison Co., W. A. Brackenridge, Vice-President and General Manager.
Oceanside—Oceanside Elec. & Gas Co., A. S. Hargreaves, Mgr.
Ontario—Ontario Power Co., G. D. Smith.
Riverside—Southern Sierras Power Co., A. B. West, Vice-Pres.
San Diego—San Diego Cons. Gas. & El. Co., H. H. Jones, Mgr.
San Francisco—California Oregon Power Co., J. D. Grant, Pres.
San Francisco—Coast Counties Gas & Electric Co., S. W. Coleman, President and Manager.
San Francisco—Great Western Power Co., W. W. Briggs, General Agent.
San Francisco—Northern California Power Co., W. F. Detert,
San Francisco—Pacific Gas & Electric Co., J. A. Britton, Vice-President and General Manager.
San Francisco—Sierra & San Francisco P. Co., H. F. Jackson, President.
Sonora—Tuolumne County Elec. Power & Lt. Co., H. J. Coffill, Manager.
Stockton—Western States Gas & Elec. Co., Sam'l Kahn, Vice-President and General Manager.
Visalia—Mt. Whitney Power Co., B. M. Maddox, Vice-Pres.
Turlock—Yosemite Power Co., P. M. Longan, Manager.

Nevada

Elko—Elko-Lamoille Power Co., B. G. McBride, General Mgr.
Ely—Ely Light & Power Co., Arthur Smith, General Manager.
Goldfield—Nevada-California Power Co., F. B. Mechling, General Manager.
Reno—Truckee River Gen. El. Co., Geo. A. Campbell, Gen, Mgr.
Lovelock—Lovelock & Woolsey Lt. & Power Co., S. R. Young, General Manager.

New Mexico

Albuquerque—Albuquerque Gas, Electric Light & Power Co., W. P. Southard, Manager.
Carrizozo—Lincoln Co., Lt. & Pwr. Co., J. E. Wright, Manager.
Carlsbad—The Public Utilities Co., E. A. Roberts, Manager.
Deming—Deming Ice & Elec. Co., J. A. Shepard, Manager.
Gallup—Citizens Lt., Power & Teleg. Co., K. H. Meyers, Mgr.
Las Vegas—Las Vegas Lt. & Power Co., W. S. Townsend, Mgr.
Lordsburg—Lordsburg Elec. Co., W. F. Ritter, Manager.
Las Cruces—Las Cruces El. Lt. & P. Co., D. W. Morgan, Mgr.
Raton—Raton Elec. Light & Pwr. Co., J. R. Smith, Manager.
Roswell—Roswell Gas & Elec. Co., C. M. Einhart, Manager.
Santa Fe—Santa Fe Water & Lt. Co., Frank Owen, Manager.
Silver City—Silver City Power Co., M. R. Buchanan, Manager.

AN UNUSUAL LEAKAGE PHENOMENON

Sir:—We send you herewith a photograph which may be of interest for your "Sparks" column. This shows the effect of an 11,000-volt wire having dropped on clayey soil and the consequent flow of leakage or charging current (the

Baked Clay for Short-Circuiting an 11,000-Volt Line

system being normally ungrounded) has baked a piece of pottery as shown. This piece will ring like a sound insulator. Evidently the current has followed the roots of some weed, thus causing the particular root-like form shown.

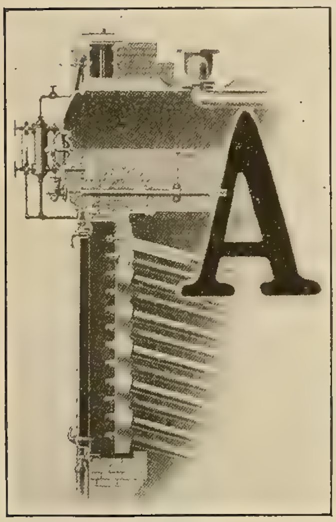
L. M. KLAUBER,
Supt. Elec. Dept. San Diego Con. Gas & Elec. Co.

FUEL OIL AND STEAM ENGINEERING

(Steam and water play an important role in fuel oil practice. In order that the student may grasp the fundamental principle whereby heat is first absorbed by water in the boiler and still more heat absorbed, when steam is formed and later superheated, he must understand the laws governing heat absorption. In this article the author sets forth the fundamental principles involved in the making of saturated and superheated steam. A formula is deduced for computing the total heat of saturated steam which, though simple, is of great importance in fuel oil and steam enginering practice and will be the basis from which more intricate laws will be later deduced.—The Editor.)

WATER AND STEAM IN FUEL OIL PRACTICE

BY ROBERT SIBLEY



A Typical Boiler Setting in Fuel Oil Practice

As we look about us in nature, we find that all inanimate creation presents itself to us in three distinct physical states. Certain bodies, for instance, of themselves readily maintain their shape while others, although non variant in density, nevertheless seem to have no particular physical configuration but seek, due to the force of gravitation, the lowest level attainable and consequently must as a rule be held in a containing vessel. On the other hand, a third class of bodies is found not only possessing no particular physical configuration, but which actually seem inherently desirous of expanding to such an extent that they must as a rule be completely housed, bottom and top, in a containing vessel.

In the class room or in the power plant, it is easy to find illustrations of these three general classifications. Thus, chalk, iron pipe, and coal are instances of the first division and are known as solids. Crude petroleum, water, and kerosene are instances of the second division, and are called liquids. Finally, air, steam, and producer gas illustrate the third division, and are called gases.

These States are Possible to all Bodies.—The most interesting thing about these socalled states of matter, and indeed the item of most importance to the engineer, is that by varying the pressure externally forcing itself against the sides of any one of these bodies and by adding or subtracting the heat that may be held in store within the body itself, any solid may be converted into a liquid and then into a gas, or any liquid may be converted into a solid or a gas, or any gas may be converted into a liquid then into a solid.

The Fundamental Principle in Steam Engineering.—It is this property of matter that makes the operation of the steam engine possible. For if we were not able to heat water and convert it into steam, it would be impossible to make use of this liquid for steam engineering purposes, although it is the most widely distributed in nature.

Again, since fuel oil must be converted into the gaseous state before it readily and efficiently burns beneath the boiler, it would certainly be cumbersome and impractical for its use in the great majority of central stations if it could not be conveyed through pipes or in oil tanks as a liquid from the oil fields to the place of consumption.

Steam Engineering Still Supreme.—Since water is so widely disseminated in nature and since it can be readily and efficiently changed from one state to another, it is the working substance that today still drives the vast majority of power developing mechanisms in the industries in spite of the rise of the gas engine and the great modern evolution in water power development.

Let us then trace the physical phenomena that accompany the transformation of water into the solid state which of course is necessary in the production of ice, and again from the liquid to the gaseous state which becomes necessary in the production of steam.

The Formation of Ice.—Let us first start with a pound of water at ordinary temperatures—say at 62° F. As we begin to lower the temperature, in other words to draw off heat, the volume slightly decreases. Thus the pound of water now occupies less space than formerly. Hence, if this water was on the surface of a mountain lake and the night was getting cooler, the surface water would sink to the lake bottom and allow warmer water from the bottom to rise only to be cooled at the surface to again drop to the bottom. This is what is known as water circulation and is very important in steam generation, as we shall see later.

When, however, the water under consideration lowers to a temperature of 39.4° F., a strange thing happens. Something develops in its internal structure that now makes the water expand as the temperature is further lowered. A unit volume of water now becoming lighter than formerly, no longer will it sink to the lake bottom but remains on the surface. Hence when a short time later the water on the surface is lowered to 32° F. or freezing point, ice is formed on the surface only, since water is a poor conductor of heat. Nature thus protects the fish in the waters below.

Coming back from the mountain lake, however, to the formation of ice in the ice plant, when the temperature has reached 32° F., although heat be now driven off, the water does not lower itself in temper-

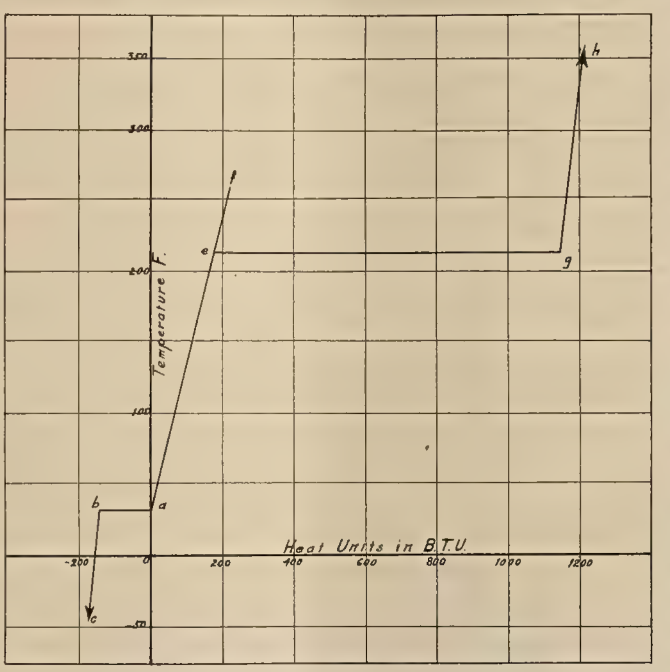
ature but remains at this temperature until it has all been converted into ice.

Latent Heat of Fusion.—The quantity of heat necessary to form one pound of ice at 32° F. from one pound of water at 32° F. is a definite measurable quantity and is known as the latent heat of fusion. By careful measurement, the latent heat of fusion for water has been found to be 142 B.t.u. That is, to convert one pound of water at 32° F. into ice at 32° F. requires the drawing off of as much heat as would approximately be required to lower one pound of water one hundred forty-two degrees in temperature.

When this pound of water is converted into ice, its volume still further expands. Hence, one pound of ice will float in water. This accounts, of course, for the floating of icebergs on the water surface, and furthermore this sudden increase in volume accounts for the rupture in pipes and other nuisances that occur in severely cold weather.

Going back to our pound of water now converted into a pound of ice, let us again proceed to draw off heat. It is now found that we may lower the temperature of the ice much more easily than when it existed as a liquid. Indeed only about one-half the heat is required per degree lowering in temperature while its volume practically remains constant.

The Formation of Steam.—Let us now proceed to a consideration of the physical changes and phenomena that occur when water passes into steam. Starting with water at say 62° F., as we add heat the temperature increases at the rate of about 1° F. for every unit of heat energy added to the water. At the same time the volume slightly increases. Hence, if our pound of water under consideration be situated at the bottom of the well-known tea-kettle, the observation of which led James Watt to the invention of the steam engine, this pound of water becoming now less dense will rise to the top and cooler water at the top will sink to the bottom which in turn is passed again to the top as it becomes heated to make way for more water from the top to be heated along the portion exposed to the heat application. Thus the water becomes warmer and warmer and the transference from bottom to top continues. The ease with which this transfer of heated bodies of water takes place has much to do with efficient operation of the steam boiler which may be likened to an enlarged tea-kettle with accessories and appurtenances to care for its increased responsibilities as compared to tea-kettle operation.



THE TEMPERATURE HEAT DIAGRAM

Here is graphically indicated the history of a pound of water in its relationship with temperature and heat. Beginning at 32 deg. F. and atmospheric pressure, by drawing off heat the horizontal line ab is traced, showing that the temperature remains constant until the water is completely converted into ice, after which the temperature rapidly falls at the rate of about one degree for every half unit of heat drawn away. By the addition of heat, however, at point a, the curve ae is traced, which indicates that the temperature rises with absorption of heat at the approximate rate of one degree for each unit of heat absorbed. At 212 deg. F. and atmospheric pressure the horizontal line eg is traced until 970.4 B.t.u. are absorbed. After all the water is thus converted into steam the curve gh is traced for superheated steam, which rises at the rate of about one degree for every .47th of a B.t.u. absorbed.

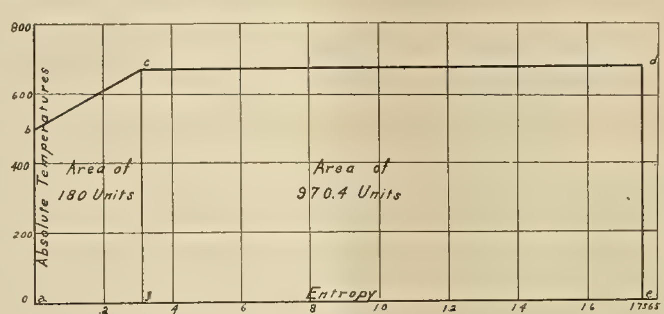
Latent Heat of Evaporation.—The water in this manner continues to absorb heat until if under atmospheric pressure, it reaches a temperature of 212° F. At this point, however, vast quantities of heat may be added and still the water will remain at this temperature although it may now be observed that steam is being formed which too, has the same temperature as the water. Not until 970.4 B.t.u. or sufficient heat units to raise ten pounds of water almost one hundred degrees in temperature have been added to the pound of water at 212° F. will the pound of water become entirely converted into steam at 212° F. This quantity of heat necessary is important in steam engineering and is known as the latent heat of evaporation for water under atmospheric pressure conditions. To be succinct, in steam engineering practice the quantity of heat necessary to convert one pound of water at a given temperature and pressure into dry steam at the same temperature and pressure is known as the latent heat of evaporation for that temperature and pressure and is usually expressed by the symbol $\mathbf{L}_t$. Steam boilers seldom operate at a pressure so low as that of atmospheric conditions. Indeed, while such a pressure is but 14.7 lb per sq. in., the modern boiler in the central station operates at something like ten to fifteen times this pressure. This fact materially complicates computation in steam engineering, for it is found that at pressures different than that of standard atmospheric conditions the latent heat of evaporation is wholly different. Indeed, so complex is this law of variation that no one as yet has been able to give an exact formula for its determination, although in subsequent chapters approximate equations will be set forth. Hence, it has become necessary to refer to carefully compiled steam tables for such information and a later chapter will set forth the manner of their use.

Other Variations Occur With Changes of Pressure.—When water passes into steam, the volume—say of one pound—vastly increases. At atmospheric pressure the volume of steam is about sixteen hundred times what it was when existing as water. At other pressures the volume relationships will of course be different. Again when the pressure increases at which steam is formed, the volume be-

comes less in proportion. No accurate mathematical formula has been found for this relationship, hence once again must we appeal to the steam tables.

Data Easily Taken from Steam Tables.—By experiment it has been found that varying amounts of heat are required to raise water from a particular initial temperature to the boiling point, for the boiling point is not reached until a higher temperature is attained as the pressure is increased. On the other hand, less heat is required to convert a pound of water at these higher boiling points into steam. Since the volume and density too vary under varying pressures, the entire problem now becomes one of picking the proper constants for the particular temperature and pressure under discussion and when one by a little practice can use the steam tables with facility, it is surprising to see how simply and directly most problems in steam computation may be solved.

Total Heat of Steam.—Often in steam engineering practice problems arise in which we must express the total heat of steam quantitatively represented in each pound under consideration. It makes little difference at what point we begin to estimate such heat relationships, but by common consent the freezing point of water has been adopted. Hence, the total heat of steam is the heat required to raise one pound of water from 32° F. to the boiling point added to the heat required to convert this water into steam at that temperature. If the steam exist as superheated steam, there must also be added the heat required to raise dry saturated steam to the temperature of superheat. The various mathematical formulas for computing these numerical results will be taken up later in the chapter entitled Quality of Steam.



THE TEMPERATURE ENTROPY DIAGRAM

By the invention of a fictitious quality of water and steam, known as entropy, the plotting of a diagram is made possible, so that an area represents heat added. Thus, in the diagram above, the abscissas are entropy and the ordinates absolute temperatures. The area abef is exactly 180 units, which is the heat required to raise water from 32 deg. F. to 212 deg. F. Similarly, the area fcde is 970.4 units, which is the heat required to evaporate one pound of water at 212 deg. F. into steam at 212 deg. F.

At this particular time we shall write down the simplest of these formulas as an illustration.

Total Heat of Dry Saturated Steam.—The total heat of dry saturated steam, written **H**, for a given temperature **t**, is the sum of the heat of liquid and latent heat of evaporization for that temperature.

Hence we may write this important fundamental equation

$$H_t = h_t + L_t \quad \ldots\ldots (1)$$

Thus the total heat of steam at 212° F. is

$$H_t = 180 + 970.4 = 1050.4 \text{ B.t.u.}$$

Other Instances of Total Heats.—If, however, the steam is evaporated from the water and then superheated, that is, an additional quantity of heat is added after all the water has become steam, it will then begin to rise in temperature and the quantity of heat necessary for each degree rise in temperature is about one-half that required per degree rise when it existed as water. This exact ratio is however quite variable and ranges between .46 and .60 depending upon the pressure and degree of superheat attained. Hence once again appears the necessity of steam tables.

It is now readily seen that in general three definite and distinct considerations present themselves in the solution of problems involving the computation of total heat. The first instance is one in which the steam exists in a dry state and at the temperature and pressure at which it is generated from the water. Such steam is known as dry saturated steam. The second instance is that in which the steam is not completely dry, but holds in suspension small particles or globules of water, and in this instance the mixture is known as wet saturated steam. The third instance is of especial importance in modern central station practice and involves what is known as superheated steam. In this case the steam is first formed by evaporation from water into dry saturated steam, after which it is conveyed through pipes that are exposed to high temperatures, thus causing the temperature of the steam to be still further raised, although the pressure practically remains constant.

The complete solution of these three instances for computation of total heats will be found in the chapter on Quality of Steam as stated above. Meanwhile the thorough mastery of the fundamentals of the physical properties of water as herein set forth will be of vast assistance in a clear understanding of this later discussion.

Examples

1. The water entering a feedwater heater is at a temperature of 75° F. and leaves the heater at 190° F., what is the heat absorbed per lb. of water?

From the steam tables the heat of liquid at 75° F. is 43.05 B.t.u. and at 190° F. it is 157.91 B.t.u. Hence the heat absorbed per lb. of water is

157.91 — 43.05 = 114.86 B.t.u.—**Ans.**

2. Water enters a boiler at 160° F. and is converted into dry saturated steam at 200 lb. pres. per sq. in. abs., what is the total heat required to evaporate each lb. of steam?

The heat in the entering water at 160° F. is from the steam tables 127.86 B.t.u. The total heat of dry saturated steam at 200 lb. pres. abs., is 1198.1 B.t.u. Hence the actual heat necessary to evaporate each lb. of steam is

1198.10 — 127.86 = 1070.24 B.t.u.—**Ans.**

3. If the heat of liquid for boiling water at 212° F. is 180 B.t.u. and the latent heat of evaporation is 970.4 B.t.u., how much heat is required to evaporate a pound of water from an open water heater which is receiving its supply at 64° F.?

Each lb. of water entering at 64° F. has a heat of liquid of 32.07 B.t.u. Water evaporating into steam at 212° F. has a heat of liquid of 180 and a latent heat of evaporation of 970.4 B.t.u., making a total heat of evaporation of 1150.4 B.t.u. for every lb. of water so evaporated. Hence the net heat required is 1150.40 — 32.07 = 1128.33 B.t.u.—**Ans.**

SPARKS—Current Facts, Figures and Fancy

(New applications of electrical energy and new methods of generating this vital fluid are to be found in the following lines. Other facts, figures and fancy also to be found below may serve their purpose, too, in giving you inspiration for more effective work in your particular line of activity.—The Editor.)

Far less than one per cent of the homes in the country are wired for complete electric service.

* * *

There is a movement on foot to standardize catalog copy into one master catalog for the purpose of saving paper and for bringing about other economies that are self-apparent.

* * *

Due to the unprecedented advance in electrical invention it is now possible to obtain over a thousand per cent more of electric light for the same money than it was twenty years ago.

* * *

January was the coldest month experienced in California for a period of twenty-one years, according to the Weather Bureau. It was a little severe on civilians, but the central station man was observed to wear a happy smile throughout it all.

* * *

Of the twenty million homes in the United States it is estimated that fully fifteen million of them are yet unwired for electric service. A gigantic campaign is now on the country over to materially reduce this vast field at present unserved by electricity.

* * *

If you are new on the job be careful. Statistics show that more than forty per cent of the employes injured in several public utility companies, and in one large company sixty-two per cent were in the service of the company less than one year when injured.

* * * *

A geological map of California has just been issued by the state mineralogist, which shows not only the geological features of the state, but also the railways, state highways and other roads, electric transmission lines, oil and gas pipe lines, and a host of other useful information.

* * *

The winds of Pacific lands have often been harnessed for water pumping but little application has been made for generating electric power. Now that a Wisconsin inventor has successfully accomplished this feat, it would seem that inventors of the West might well apply their genius in carrying this problem further in the solution of Western needs.

* * *

Ships making the transit through the Panama Canal during December were divided by nationalities as follows: British, 63; United States, 37; Norwegian, 15; Chilean, 8; Peruvian, 7; Dutch, 6; Japanese, 5; Danish, 4; Costa Rican, 3; Swedish, 3; Spanish, 2; Cuban, 1; Mexican, 1. Traffic was greater by seven ships and 47,610 net tons, Panama Canal measurement, than for the month of November.

Over one hundred million incandescent lamps are now sold annually or more than sufficient to illuminate an array of mile posts from the earth to the sun.

* * *

Fifteen hundred employes and associates participated recently in assisting Thomas A. Edison to celebrate his seventieth birthday. If each one present had insisted on the traditional "hearty spank for each year with one to grow on," the famous inventor would undoubtedly have been forced to put out a new multiform protector of some sort under such a broadside from an assemblage of this proportion.

* * *

A comparatively little known but valuable tree most often called a slash pine is fast replacing longleaf pine in many sections of the South, says the Forest Service. In some respects this tree is considered a better tree than longleaf. Its growth, according to the foresters, is more rapid and its yield of turpentine larger, while the wood is said to be the heaviest, hardest and strongest coniferous wood grown in the country.

* * *

German agricultural reports show that by feeding the soil with two million tons of nitrate there was secured an increase in crops of sixty-three million tons. Current authorities agree that one and one-half horsepower of hydroelectric energy will produce a ton of sodium nitrate per year. Gigantic water powers are available in the West and this possible increase in fertility of the soil is a very happy source of contemplation for the Western power owner and for the agriculturist.

* * *

That excessive profits are to be prevented in the event of hostilities is indicated by the fact that the Council of National Defense has called on the Chamber of Commerce of the United States for assistance and advice in purchases to be made by the army quartermasters. The National Chamber recently passed a resolution providing that the basis of supply of government requirements in war and peace from private sources should be at a rate of profit so low as to preclude a profit interest in war.

* * *

Electricity has been found to have a new function other than to light the world and make the wheels of industry go round. According to Professor Silas Wentworth, stock grower of Los Gatos, it can be used to make two or three sheep grow where only one grew before. Professor Wentworth reports that because the heavily charged lines of the Great Western Power Company extend across the farm of Librarian John F. Tyler of the State Supreme Court, new-born lambs on the Tyler ranch are coming in triplets and twins.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

Selling the Electrical Idea

The recent census statistics that show forty farmers of the Middle West as owning forty automobiles while bath tubs to the number of three were all that could be inventoried among the group, brings to light a very important psychological point in salesmanship. The idea of the automobile has been sold the country over while the idea of the bath tub is evidently wofully in the background, or else totally absent in some instances at least. The nation is becoming more and more "sold" to the electrical idea. Co-operation is working wonders in every section of the country. The splendid results that are daily coming in bear out the fact that it is this national idea that must be emphasized in all advertising and not the individual self-centered idea that formerly was uppermost in the minds of men of the industry. Putting over the electrical idea in true hand to hand co-operation, devoid of cut-throat competitive small bickerings, is indeed worthy the aim of those far-sighted captains of industry now engaged in forwarding this important phase of modern industrial life.

American Non-use of Metric System

The non-use of the metric system in the United States among engineers and among the trade is beginning to be felt as a serious handicap in American efforts to secure a commercial and engineering foothold in South America.

Our consular reports are full of statements to this effect. Take for instance the greatest republic of South America. Brazilians are unfavorably impressed when they receive commercial correspondence in which references are made to feet, yards, and miles, instead of the meters and kilometers to which they are accustomed. Within the past decade there has been a strong tendency in American export trade to encourage the employment of invoice clerks who make out documents not only in the language but also in the measurements of the country to which the goods are directed.

Details of the practice among business houses in various lines in Rio de Janeiro have been obtained by the American consulate general and show how important it is that exporters should pay special attention to this phase of the commerce between nations.

Now is the time for engineers the country over to exert every influence in promoting the use of the metric system at home and abroad.

And the best way to do this is for each one of us to begin to think and act in this system of units and put aside our outgrown garments of feet, inches, pounds, yards and the like, and speak only in metric units, the now recognized scientific system of all enlightened nations.

Familiarity With Foreign Exchange a Necessity

Engineers of the West have long since accustomed themselves to all the necessary forms of credit systems of American banking institutions at home. Little attention has, however, been given to methods in vogue in the foreign exchange. Not until the engineer endeavors to connect up with the home office when out on his first foreign business visitation does he find how wholly ig-

norant he is on the subject and indeed how lacking American banking facilities are in the countries bordering the Pacific.

This one feature in our modern commercial and engineering life has done much in retarding American engineering activities in these countries.

Rapid strides are being made by the Federal Reserve Commission at Washington to better this state of affairs. The leading article of this issue is devoted to a discussion of this phase of recent progress in banking facilities by a well-known Western authority on foreign exchange methods.

Engineers of the West can do much in still further increasing banking facilities and incidentally commercial and engineering interchange with our Pacific Coast neighbors by giving this matter their thoughtful attention and endorsing every worthy move that is being made to forward American banking representation in these lands.

Lack of Accountancy in Electrical Contracting

Commercial specialists at Washington who have been investigating the cause of business failure have come to the conclusion that in a large majority of instances this disaster has occurred due to the lack of knowledge on the part of the operator as to the exact status of his business. Investigation into failures among electrical contractors and other branches of the electrical industry has found this lack of business knowledge in accountancy to be especially glaring.

Ignorance of proper methods of computing and making allowances for depreciation and overhead segregations has been the death knell of many a promising young business institution in this industry.

The need for this knowledge is most pressing. The present rather warped profits that are possible due to abnormal conditions in the buying world are especially to be allowed for with due discretion otherwise disaster is bound to occur on the downward decline of prices of material that are sure to come.

The most casual consideration of the matter shows a gross lack of knowledge in accountancy among men of the industry. This lack of knowledge could be remedied in many instances in the electrical industry in so far as the future is concerned by remodeling to a certain extent the curricula of technical institutions whence these young men acquire their training.

The need for accountancy in engineering is each day growing more emphatic and the somewhat lessening need for men of otherwise highly technicalized training is each day becoming more self evident. Hence it must be admitted that the young engineer to be a success must be prepared to handle fundamental considerations in accountancy, even if training in highly specialized subjects must consequently be somewhat neglected.

More and more it is becoming evident as time goes on that the essential training needed for the young engineer should consist of thorough versing in business method and a thorough grounding in the fundamental laws of mathematics, chemistry and physics.

Prepared in this manner the young engineer can successfully cope with practically any problem that may arise, while the young man who spends too much time in highly specialized subjects in his undergraduate days at college will find himself unable to handle the highly diversified subjects that arise in the daily life of the man in the engineering profession or engaged in the various problems that arise in the electrical industry.

A Research Agency Needed

The problems in development of domestic water supply in cities of the West are fast assuming nationwide proportions at least in so far as notoriety and investment of capital involved are concerned. Especially is this true among what are known as the Bay Cities of California—San Francisco, Oakland, Berkeley, Alameda, Richmond and other communities. It is truly surprising to note with what fervor each distinct community is putting forth its pet mountain supply or other source as the one and only one to be considered.

The entire problem is intricately interwoven with the future of hydroelectric development on the Pacific Coast for many of the proposed domestic supply projects involve the ultimate development of gigantic water powers as side issues.

Since these cities are growing by leaps and bounds, practically every engineer who has familiarized himself with the conditions to be met will agree that the local sources, fully developed, at best will prove adequate for less than a score of years ahead.

The problem, then, necessitates the wisest foresight possible. To develop an adequate supply for a fifty-year period hence for all the bay cities combined will call for an investment of something like a hundred million dollars.

To mention this amount of money in one breath is one thing and to raise this sum is another. Every advance in modern engineering accomplishment has brought out one noteworthy fact that unity in development, free from duplication or paralleling of effort, is a fundamental economic principle emphatically to be borne in mind.

The time has come in the development of community of interest in these cities of California that engineers be employed to assist in judiciary advice.

It is clearly the duty of the Railroad Commission to bear this idea of unity of development in mind when determining the necessity of public convenience experienced in proposed enlarged expenditures of public funds now before it for consideration. While the commission itself, due to its judiciary functions may not feel it should actively formulate a body of independent investigators for this enlarged activity, still every industry, every agricultural development, every power company from the Tehachapi to Mt. Shasta is shaken to its very depths in one way or another by some of the schemes proposed for these enterprises.

A free and above-board citizens' agency formed to give this problem an impartial research investigation is the crying need of the hour. And the people of California as a whole would welcome such a move made by the Railroad Commission and other bodies before whom these problems must ultimately come for adjudication.

PERSONALS

C. R. Rudy, salesmanager of the Colorado Power Company, has returned to Denver from a visit to California.

George R. Murphy of the Electric Storage Battery Company, has left San Francisco for a trip through Nevada.

Guy W. Talbot, president of the Pacific Power & Light Company of Portland is spending a few weeks in California.

Geo. A. Wardlaw, editor of the Electrical Record since 1910, resigned that position on March 1 in order to engage in free lance literary work.

J. C. Zancker, northwest manager of the Federal Sign Company (Electric) with headquarters at Portland, was a recent San Francisco visitor.

Thos. G. Bradley, superintendent of plants for the California-Oregon Power Company, has been at San Francisco from Medford and Yreka.

Carl G. Schluederberg, assistant manager of the supply partment of the Westinghouse Electric Manufacturing Company, was at San Francisco recently.

Edward D. Pike of the San Francisco office of the Wagner Electric Manufacturing Company's office in San Francisco has left for an extended trip throughout the East.

Harry Whiting, president of Pierson, Roeding & Company, has left San Francisco for Del Monte and the southern part of the state partly on business and partly on pleasure bent.

C. E. Ingalls, formerly connected with the Crocker-Wheeler Company's Los Angeles office, who has more recently been with the company in the East, has just been transferred to the San Francisco office.

C. S. Hull, of the testing laboratory of the General Electric Company in San Francisco has left for Ajo, Arizona, where he will assist in the testing out of the new Cornelia Copper Company's power plant at that place.

J. B. Estabrook, secretary of The Peerless Electric Company having spent part of the winter at Phoenix, Ariz., has made a recent visit to Los Angeles and San Francisco and is now back at the company headquarters in Warren, Ohio.

C. S. Thompson, advertising manager of the Western Electric Company, is an interested visitor on the Pacific Coast where he gave a recent stirring address before the electrical men of San Francisco on national electrical advertising.

Harry Kluegel, formerly engaged with the adjudication of the water rights of the Mt. Whitney Power Company and more recently from Denver, where he has been investigating the water supply for that city, has returned to San Francisco for permanent residence.

C. H. Judson, special engineer for the Pacific Telephone & Telegraph Company, recently delivered a very interesting lecture before the Stanford University section of the American Institute of Electrical Engineers on "A Modern Telephone Exchange and of What It Consists."

W. S. Mendenhall has resigned his position as commercial manager of the Grays Harbor Railway & Light Company, at Aberdeen, Wash., to engage in the printing business under the firm name of Welch-Richards Printing Company. **C. Hugo Nelson** succeeds Mr. Mendenhall as commercial manager of the company.

Dwight D. Miller has joined the staff of The Society for Electrical Development, for the particular purpose of further developing the various uses of electricity in the different industries. The work of the society has grown to a point where it has become necessary to add another engineer to its staff engaged in this field.

department of the Westinghouse Electric Manufacturing Com-

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, has returned from Reno, Nevada, where he went in connection with the organization of a Nevada subdivision of the Pacific Coast Section of the N. E. L. A., which has been successfully consummated.

C. R. Weymouth, chief engineer of Chas. C. Moore & Company, has left San Francisco for Ajo, Arizona, where he will spend some days in testing out the new Cornelia Copper Company's power plant at that place: This plant establishes a new high record for boiler operation on the Pacific Coast as it will operate under 250 lb. pressure.

J. W. Finch, formerly commercial agent of the Southern Sierras Power Company at Riverside, California, has left on a tour of all the Central and South American west coast countries in the interests of commercial and engineering investigations for a number of principals in Los Angeles, San Francisco and other Pacific Coast cities. Mr. Finch expects to be gone twelve months.

A. P. Ramstedt, former president of the Public Utilities Commission of the State of Idaho, has resigned as a member of the commission to accept the position of general auditor and comptroller of the Day mining interests, including among others, the Hercules Mining Company, Tamarack & Custer Consolidated Mining Company and other mining companies in Idaho and British Columbia; the Northport Smelting & Refining Company at Northport, Washington; Pennsylvania Smelting Company at Pittsburg, Pennsylvania, and various banking interests in Idaho and Washington.

John A. Britton, vice-president and general manager; **D. H. Foote,** secretary; **F. G. Baum,** consulting engineer; **P. M. Downing.** chief engineer in the hydroelectric department; **Henry Bostwick,** assistant to the vice-president; **J. P. Jollyman,** engineer in charge of electric construction, and **W. G. Vincent,** valuation engineer, of the Pacific Gas & Electric Company; **William Doble,** chief engineer, and **C. S. Foulds** of the testing department of the Pelton Water Wheel Company, and **Robert Sibley,** editor of the Journal of Electricity, were among the prominent engineers that witnessed the putting in of the Wise Power Plant of the Pacific Gas & Electric Company at Auburn, California, on Sunday, March 4, 1917.

Ben B. Bessesen, mechanical draftsman, Brinkley Supply Co., Seattle, Wash.; **Claude Charles Brown,** assistant boiler room engineer, Station "A", Pacific Gas & Electric Co., San Francisco, Cal.; **Harry Boyd Dunlap,** oil flotation operator, Nevada Consolidated Copper Co., McGill, Nev.; **William Mowry Holmes,** estimator of transmission line construction, Pacific Light & Power Corporation, Los Angeles, Cal.; **Frederick Krug,** in charge of electrical equipment, and student, New Mexico State School Mines, Secorro, N. M.; **Charles Goodeil Marcy,** student engineer, General Electric Co., Montesano, Wash.; **Thomas Edward Marcum,** operator, Anaconda Copper Mining Co., Great Falls, Mont.; **John Donald Pollock,** engineer Pacific Telephone & Telegraph Co., Portland, Ore.; **Henry G. Roberts,** electrician, Canadian Consolidated Mining Co, Trail, B. C.; **Claude W. Sprague,** operator, B. & M. Smelter, Great Falls, Mont.; **Carl Orrin West,** engineering department, Home Telephone & Telegraph Co., Los Angeles, Cal., and **Adolph Frank Wolff,** substation operator, Spokane and Inland Empire Railway Co., Spokane, Wash., have been elected associates of the American Institute of Electrical Engineers.

OBITUARY.

The officers of the Habirshaw Electric Cable Company, Inc., announce with profound sorrow and deepest grief the passing of their vice-president, Captain Richard S. Satterlee, on February 15th.

B. F. Kierulff, president of Kierulff & Co. at Los Angeles, Cal., passed away on March 8th. Mr. Kierulff, a product of California and its educational institutions, leaves a host of friends, who deeply mourn his loss.

MEETING NOTICES FOR ELECTRICAL MEN

(In the following lines meetings and personal items of current interest to engineers are recorded. Efficiency study, accounting, demand meters, a discussion of California electrical utilization safety orders and other subjects have been discussed during the past two-week interval by gatherings in various Pacific Coast cities. In this issue the Journal also commences a list of Builders of The West to commemorate its thirtieth or jubilee year of publication among engineering periodicals. The first builder to be recorded is Benjamin Ide Wheeler, the much respected and beloved president of the University of California.—The Editor.)

San Francisco Section of A. I. E. E.

The San Francisco Section of the American Institute of Electrical Engineers met at the Engineer's Club Rooms on Friday evening, February 23. The subject of the evening was "Demand Meters" and the paper presenting this subject was read by W. A. Hillebrand of the Pacific Gas & Electric Company. The speaker discussed the development of the demand meter and illustrated his discussion with a series of slides. The attendance was eighty.

Oregon Society of Engineers

The regular monthly meeting of the Society was held in Library Hall, February 27, at 8 o'clock. A three-reel feature film illustrating the manufacture of steel pipe was shown and explained by O. M. Ash.

Every process in the manufacture, from the mining to the finished product was dealt with. The picture was also shown to promote the welfare work undertaken by large corporations.

Address at the Engineer's Club of San Francisco

At Friday noon of March 2, 1917, Minor Chipman of Boston, an efficiency expert, gave a most interesting address before an assemblage of eighty members on the subject of "Efficiency Study." The speaker traced the development of efficiency investigations from the early deductions of the Taylor researches down to the present time.

Scientific Societies to Meet at Stanford University in April

The second annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held this year at Stanford University during the period, April 4 to 7. Among the scientific societies which will also convene in conjunction with this meeting are the Astronomical Society of the Pacific, the Pacific Coast Section of the American Mathematical Society, the American Physical Society, the California Section of the American Chemical Society, the Cordilleran Section of the Geological Society of America, the Seismological Society of America, the Pacific Coast Branch of the Palaeontological Society, the Western Society of Naturalists, the Cooper Ornithological Club, the Pacific Slope Branch of the American Association of Economic Entomologists, and the California Academy of Sciences. Sessions of these societies will be held on Thursday, Friday, and Saturday of the period of the convocation.

BUILDERS OF THE WEST—I

BENJAMIN IDE WHEELER

The Journal of Electricity now in its jubilee year of "Thirty Years of Service," takes pleasure in recording for all posterity to read the names of the distinguished educators, executives and engineers who have been the life-giving element in building up the unprecedented engineering accomplishments of the West.

A character builder is indeed one of the highest callings that can befall the engineer. Here is a man who through classic culture has broadened the lives of men and indeed actually produced under his supervision more engineers of the West than any other living soul. Benjamin Ide Wheeler, president of the University of California, and loyally served by seventeen thousand alumni throughout the West, the Journal of Electricity feels honored in recording you among one of the engineers enrolled as a Builder of the West.

The San Francisco Electrical Development and Jovian League

The meeting of the League on Wednesday, February 28, was devoted to the subject of accountancy which was the text of an address by C. C. Staehling of the College of Commerce at the University of California. The speaker brought out the necessity of proper accounting and cost keeping for the man engaged in the electrical business and was intently followed by an unusual number of electrical contractors present at the meeting.

On Wednesday, March 7, M. S. Orrick of the Western Electric Company acted as chairman of the day who introduced P. L. Thompson, advertising manager for the Western Electric Company, as speaker of the day. Mr. Thompson spoke in an interesting and instructive manner concerning the manner of selling an idea in the electrical business and illustrated his points by exhibiting several slides which set forth the arguments now being used by his company in advertising the electrical idea throughout the nation.

Bi-Weekly Luncheon of Joint Sections of the A. I. E. E. and N. E. L. A. with Oregon Society of Engineers

This meeting was held in the orange room of the Oregon Hotel, February 28th, A. S. Moody was chairman and the luncheon was in charge of the Pacific States Electric Company. After the luncheon, the meeting adjourned to the Columbia Theater where a motion picture film, "The King of the Rails," was shown. This film showed the history and development of railroad industries, concluding with the electrification of the Milwaukee railroad over the Rocky mountains. Seventy were in attendance.

California Section of Electrical Inspectors

The regular monthly meeting of the California Section of the National Association of Electrical Inspectors was held Saturday, March 3d, in the Merchants' Exchange Building. There was a large attendance of members and a number of representatives of the various manufacturing, jobbing and engineering concerns as guests. Nearly the entire afternoon was devoted to a study of the California Electrical Utilization Safety Orders and particularly to the proposed changes in Order 703 (C-3), Grounding, and 737, Disconnection of Fusible Cutouts Before Handling, both of which were brought up for revision at a public hearing held on Friday, March 9th, in San Francisco and on Monday, March 12th, in Los Angeles.

Members were unanimous in the approval of the new proposed order covering grounding, believing that the wire sizes selected are ample for complete protection and at the

same time will permit of a lower cost for ground protection. It was suggested, however, that the range in amperes for the various sizes of ground conductors specified should agree with the maximum ampere capacity of the various standard cutout blocks, that is, the first proposed range 0 to 50 amperes should be changed to read 0 to 60 amperes, the second 61 to 100 amperes and so on, the theory being that any cutout in the system is likely to be fused to its maximum capacity. This is a good suggestion. It should be adopted.

In their discussion of the proposed changes in Order 737 both sections (a) and (b) as revised were accepted as being desirable. Paragraph (a) provides for a switch in all main circuits and branch circuits, except branch lighting circuits, for the purpose of disconnecting the fuses from all sources of electrical energy when the cutout is being re-fused. Paragraph (b) of the same order as revised provides for a switch where the current of a single circuit is separately metered, as in apartment houses, etc.

However, in the discussion of paragraphs (c) and (d) of this same order as revised, there was much diversity of opinion and no final interpretation was accepted. There was a general feeling that paragraph (d) calls for certain types of switches which are not now available in the market except in very limited numbers and these are offered by only one or two manufacturers. It was pointed out that the various manufacturers of switches are not now in a position to develop immediately lines of switches that will meet these requirements. Further, they do not wish to proceed with these developments until such time as several other States now considering the adoption of the Bureau of Standards Code, at least in part, have arrived at some standard.

It was also suggested that future revisions of the orders should be written with the greatest care to eliminate all possible chances of misunderstanding regarding their interpretation. Your correspondent agrees heartily with this suggestion. Many of the orders, as they now read, are not sufficiently clear, and it would seem that written interpretations of the various orders sent out from time to time by the commission to the various inspection bureaus and others interested would be very helpful. It is hoped that the commission will take steps to do this in the near future.

The following members were present:

W. E. Brothers, chief electrical department, Berkeley.
G. A. Cleary, electrical inspector, Board of Fire Underwriters, San Francisco.
F. R. Ellison, electrical inspector, Dept. of Elec., Oakland.
B. C. Hill, supervisoral inspector, Dept. of Elec., Oakland.
H. Abernathy, East Oakland.
G. M. Hodgkins, electrical inspector, Dept. of Elec., Oakland.
C. W. Mitchell, E. E. Board of Fire Underwriters, San Francisco.
W. A. Murphy, chief Department of Electricity, Stockton.
M. C. Sandles, electrical inspector, Dept. of Elec., Oakland.
P. Anderson, electrical inspector, Dept. of Elec., Oakland.
A. V. Youens, electrical department, Palo Alto.
L. Wierda, electrical inspector, Richmond.
J. I. Dixon, city electrician, Santa Clara.
A. Kempston, superintendent fire alarms, City of San Francisco.
W. Pennycook, electrical inspector, Dept of Elec., San Francisco.
T. M. Robinson, city electrician, Fresno.
W. A. Spencer, city electrician, San Jose.

Oregon Association of Electrical Contractors and Dealers

The Oregon Association of Electrical Contractors & Dealers, held its quarterly meeting at Portland, Oregon on February 21, 1917. This meeting was the largest affair ever held in the history of the present association.

At noon an executive meeting was held at the chamber of commerce at which the entire executive committee met with all of the out of town members and the local jobbers, at which time the state of the organization was fully discussed, and after which William Bristol addressed the meeting at length.

At 3:30 p. m. the meeting was adjourned and the visiting members were assigned to autos and driven for a trip over the Columbia River Highway, after which they were taken to the Crown Point Chelat, where they were soon joined by a large number of electrical men from Portland, and other cities.

California Association of Electrical Contractors and Dealers

The regular monthly meeting of the Association was held at Sacramento February 24th, with a large and enthusiastic attendance. The principle business transacted at the afternoon meeting was a discussion of the question of "Trade Acceptances"—whether they should be endorsed and adopted by the contractors. As a great diversity of views existed, a special committee consisting of H. C. Reid, T. E. Bennett and C. F. Butte was appointed to report with recommendations at the next business meeting. W. D. Kohlwey made a strong plea for a greater membership of California contractors in the national organization. This matter was referred to a committee consisting of Frank Watts, P. Decker and J. Hetty. It was decided to hold the annual convention in July at Santa Rosa. The convention committee consists of W. E. Hayes, E. E. Browne and M. A. De Lew.

At the joint dinner of the jobbers and contractors in the evening A. E. Brockway presided as toastmaster. After a brief word of welcome he called on M. A. De Lew to report on the progress of the San Francisco Section. After tracing the early efforts of the local and giving a glowing tribute to W. L. Goodwin, Mr. De Lew discussed integrity as the one basis for successful organization.

J. C. Hobrecht then gave a general talk on what was wrong with the electrical industry, his conclusion being ignorance of business methods by the contractor and the extension of long credits by the jobber. He showed where the contractor was too willing to sacrifice profit in order to beat a competitor to a job. The average dealer is more of a mechanic than a business man and does not realize that his work must always be done at a profit. He seldom has enough capital to carry him through and fails to recognize the necessity for taking care of the overhead. Inasmuch as the jobber's prosperity is dependent upon the dealer's prosperity this becomes a problem for the jobber to consider. He stated that in the other lines of business, as in the electrical industry, 55 per cent of sales are due to the dealer's influence, the other 45 per cent being traced to advertising. He said that the jobber should not only see that the dealer is able to pay for the goods he orders but should also investigate his financial ability to carry out the work he starts. Easy credit from a jobber encourages men with insufficient capital to take up contracting work to the detriment of the established dealers. Furthermore, the central station should take an active interest in the dealers' welfare as it needs the co-operation of both the jobber and the contractor.

D. E. Harris, in analyzing the factors that contribute to business success, stated the necessity for co-operation between capital, as represented by the manufacturer and jobber, labor, as represented by the contractor, and the consumer, as represented by the general public. He showed that rivalry without co-operation means reckless competition. He stated the jobbers are studying how to improve conditions and realize the necessity for mutual co-operation. He presented figures showing that more than half the orders filled by jobbers are for less than $5 and suggested that both the jobber and the dealer would save money by a bunching of orders.

A. H. Halloran explained the aims and purpose of the new Pacific Coast Section of the National Electric Light Association, comprising the central stations in California, Nevada, Arizona and New Mexico. He detailed the methods of working and talked of the division of association activities into engineering, accounting and commercial lines. By a recent ruling there will be adequate representation of the contractor, jobber and manufacturer on the executive committee and especial attention is to be paid to co-operative methods of appliance merchandising. He urged that the contractor co-operate with this new organization.

C. F. Butte, spoke of the relation of the electrical business with allied industries, such as plumbing and steam fitting. He showed that a profit of 25 and 20 gives only 11 1/3 per cent and urged that all business be done at least on this margin. He also suggested more close affiliation with the National Electric Contractors' Association and briefly outlined the plans of the Western Conference Board. He stated that affiliation with the commercial section of the National Electric Light Association should bear good fruit for the contractor.

L. H. Newbert told of the ways in which the Pacific Gas & Electric Company was encouraging the contractor-dealer, particularly as regards the discontinuance of house wiring and the sale of lamp socket appliances. The policy of his company is to give the dealers an opportunity to sell wherever they will take advantage of it. They are willing to assist the contractors in every way in the upbuilding of their association.

Henry Holland stated the Great Western Power Company was ready to join the association and willing to co-operate with the contractor.

Brief remarks were also made by G. B. Baldwin, T. J. Dunn, M. S. Orrick, F. J. Cram and H. C. Reid, who spoke on the progress that has already been made by the association and their future intentions as regards sales campaign, credit betterment and the distribution of information. R. Goold, J. Gensler and H. H. Courtwright told what was being done by the several local associations and the parting words were given by President Somers.

The following were in attendance:

Jefferson W. Asher, Asher Electric Co., San Francisco.
T. E. Bennett, Rex Electric Co.
C. W. Beaton, City Electrician, Sacramento.
B. B. Baldwin, Pacific Gas & Electric Co., Sacramento.
A. E. Brockway, Latourrette-Fical Co., Sacramento.
E. E. Browne, H. S. Tittle Co., San Francisco.
C. F. Butte, Butte Engineering & Elec. Co., San Francisco.
California Mech. & Electric Co., Sacramento.
H. H. Courtwright, Valley Elec. Supply Co., Fresno.
H. A. Case, Western Electric Co.
F. J. Cram, Electric Appliance Co., San Francisco.
C. L. Chamblin, California Electric & Const. Co., San Francisco.
M. A. De Lew, San Francisco.
P. Decker, Decker Electric Co., San Francisco.
T. J. Dunn, Great Western Power Co., Sacramento.
Electric Machinery Equipment Co.
C. A. Felix, Great Western Power Co., Sacramento.
M. Flatland, Globe Elec. Co., San Francisco.
J. Gensler, Elec. Const. Co.
R. Goold, Goold & Johns, Stockton.
H. H. Hoxie, Elec. Ry. & Mfgrs. Supply Co., San Francisco.
B. G. Hannon, Great Western Power Co., Sacramento.
J. C. Hobrecht, J. C. Hobrecht Co., Sacramento.
A. H. Halloran, Journal of Electricity, San Francisco.
M. E. Hickox, Pacific States Electric Co., San Francisco.
Wm. Hemington, City Protective Electric.
D. E. Harris, Pacific States Electric Co., San Francisco.
C. E. Hall, Great Western Power Company.
Henry Holland, Great Western Power Co.
D. E. Johns, Goold & Johns, Stockton.
Frank Killam, Pacific States Electric & Mfg. Co., San Francisco.
C. B. Kenney, Ne Page-McKenny Co., San Francisco.
R. King, King Electric Co.
W. D. Kohlwey, Kohlwey, Smith, Alfs, San Francisco.
G. J. King, Oakland.
F. C. Libby, Scott, Lyman & Stack, Sacramento.
W. B. Lewis, Western Electric, Sacramento.
F. C. Lyman, Secretary, Stockton-Local, Stockton.
C. A. Lamus, Graham & Lamus Co., Sacramento.
C. W. McKillup, Pacific Gas & Electric Co., Sacramento.
F. H. Mills, Electric Appliance Co., San Francisco.
F. E. Newbery Electric Co.
Nevada Electric Co., Sacramento.
Lee H. Newbert, Pacific Gas & Electric Co., San Francisco.
M. S. Orrick, Western Electric Co., San Francisco.
A. P. Peck, Holabird-Reynolds Electric Co.
H. C. Reid, Pacific Fire Extinguisher Co., San Francisco.
Standard Electric Works, Sacramento.
H. T. Schultz, Electric Appliance Co.
Frank J. Somers, San Jose, Cal.
T. Scott, Scott, Lyman & Stack.
C. J. Thelen, Electric Rwy. & Mfgrs Supply Co.
F. Waxon, Waxon Bros.
Carl F. Wolf, Standard Elec. Construction Co., San Francisco.
Frank W. Watts, McFell Electric Co., San Francisco.
Western Gas & Electric Appliance Co., Chico.
Wallace & Smith, Lodi.
A. Youngholm, Electric Rwy. & Mfgrs. Supply Co.

NOTES OF CALIFORNIA WATER COMMISSION

Ed Fletcher of San Diego has applied for 30 cu. ft. per second of the waters of Santa Ysabel Creek and Black Canyon Creek, tributary to the Santa Ysabel River, in San Diego County, for the development of hydroelectric power for commercial use. Data filed with the application specifies a pipe line five miles long with a feeder from Black Canyon over a mile in length. The diversion from Santa Ysabel Creek is proposed by means of a dam, which shall also be a storage dam, to be 110 ft. high, 800 ft. long on top, 150 ft. long on bottom, of concrete, multiple type, capable of holding back 11,865 acre feet of water. The diversion dam in Black Canyon Creek is specified as a small concrete structure 5 ft high, 10 ft. long on top and 3 ft. on bottom. The total fall to be utilized is given as 890 ft. and the amount of theoretical horsepower to be developed as 3000. The estimated cost is $350,000.

Byron D. Beckwith of Colusa, 40 cu. ft. per second of the waters of the Sacramento River for the irrigation of rice, alfalfa and orchard. By means of a main canal four miles long it is intended to convey the water to 2000 acres of land.

Chas. W. Guerin of Pomona—150,000 acre feet per annum of the waters of Whitney Creek, tributary to the South Fork of Kern River in Tulare County for the purpose of irrigating lands in the Inyo-Kern Valley. The application specifies a proposed canal and pipe line 45 miles long, the project to be known as the Monache Reservoir and Inyo-Kern Canal. The data concerning the project is incomplete and the commission has given applicant until December 1 to complete the application.

The city of Los Angeles—500 cubic feet per second of the waters of Owens River for power purposes. This application is for one of the units of the proposed general power project for supplying the city of Los Angeles with light and power. There are three plants included in this application In Plant No. 1, the water is taken in a large measure from the city's Long Valley Reservoir site. The main dam specifications, as proposed, provide for a structure 150 ft. high, 520 ft. long on top and 130 on bottom of hydraulic fill with concrete core wall. The dams for the other two plants are low concrete structures. The total fall to be utilized by each plant is as follows: No. 1, 1101 ft.; No. 2, 829 ft.; No. 3, 384 ft. The power it is proposed to generate at each is as follows: No. 1, 41,000 theoretical horsepower; No. 2, 34,000; No. 3. 15,000. All water is to be returned to Owens River after being utilized for power. The cost of this unit is given in the application of $7,500,000.

In still another application Los Angeles asks for 250 cubic feet per second of the waters of the south fork of the Kern River in Tulare County for the same purpose as above. The application states that it is proposed to construct a diversion dam 20 feet high, 200 feet long on top and 50 feet on bottom of timber crib construction with earth fill and metal gates set in concrete, with 13½ miles of conduit, tunnel and pipe line, the works to be known as Kern River No. 2 Power Project.

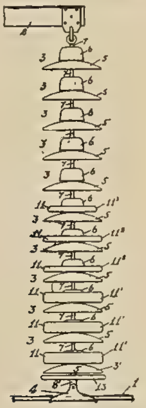
Charles K. Fox of Pomona—500 cubic feet per second of the waters of Twelve Mile Creek, 100 of Keeno Creek, 250 of Bidwell Creek and 500 of Cowhead Lake in Modoc County for irrigation. The application specifies the storage of 117,000 acre feet of water in Cowhead Lake and the irrigation of 40,000 acses of land at an estimated cost for the entire project of $800,000.

Mono Mutual Water Company of San Francisco—Incorporated December 29, 1916; 400 cubic feet per second of the waters of Rush Creek and 350 of Levining Creek tributary to Mono Lake in Mono county for irrigation and domestic purposes. The application states that there will be a canal 30 miles long to be known as the Mono canal, for the irrigation of 50,000 acres at an estimated cost of $500,000.

WHAT WESTERN INVENTORS ARE DOING

(The insulator, the dam, and even the fish-stop play important roles in Western hydroelectric practice. Below will be found briefy described recent patents that have been granted to Western inventors for improvements along these lines. Motor control and electric house-heating furnaces, much needed improvements in utilization of electrical energy, also come in for brief descriptions.—The Editor.)

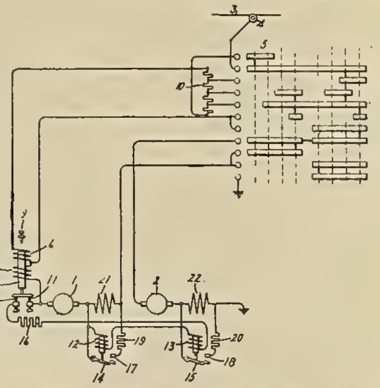
1,215,549. **Electric-Conductor-Insulating Support.** John A. Koontz, Jr., Palo Alto, Cal., assignor of one-half to Edward W. Beardsley, San Francisco, Cal., and one-fourth to Richard W. Shoemaker, Alameda, Cal.



An electric-conductor-insulating support, comprising a plurality of interconnected insulating units, and a hollow metallic disk interposed between two adjacent insulating units for increasing the electrostatic capacity thereof.

1,216,126. **Motor-Control System.** William P. Jackson, Oakland, Cal., assignor to General Electric Company, a corporation, of New York.

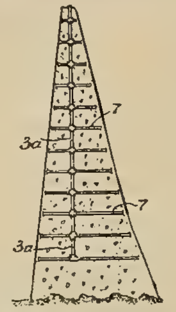
A motor-control system of a motor having a series field, a source of current for the motor, a starting resistance for the motor, means for connecting the starting resistance in series with the motor and for cutting the same out of circuit,



means for reducing the field strength of the motor, means responsive to the current in the motor circuit for operatively connecting the field reducing means in shunt to the motor armature when the current in the motor circuit falls to predetermined value, and means responsive to the current through the starting resistance for preventing the connection of the field reducing means in shunt to the motor armature until the starting resistance has been cut out of circuit.

1,216,234. **Dam Construction.** Lars R. Jorgensen, South Berkeley, Cal.

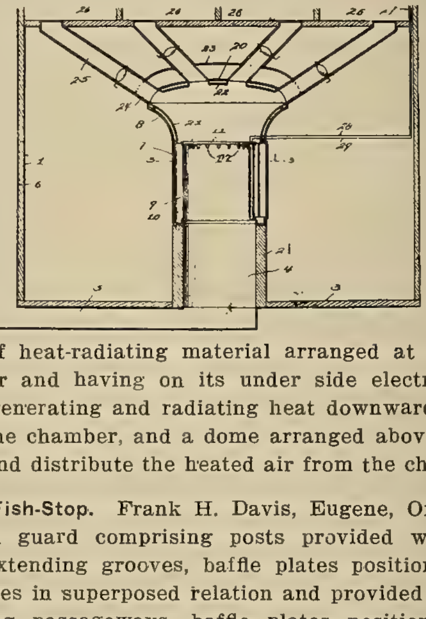
A dam body having grout pipes inserted in the contraction joints and distributed over the whole section, the ends of these pipes preferably flattened to form a slot and the sides of the pipes provided with short longitudinal slots at spaced intervals, these permanent pipes having movable pipes of smaller diameter inserted, the space between the two pipes being made tight at the lower end of the movable pipe by means of a packing, and the lower end of the movable



pipe serving as a discharge for the grout into the large pipe and the upper end being connected to a grout pump.

1,216,101. **Electric House-Heating Furnace.** August C. Fingerle, Modesto, Cal.

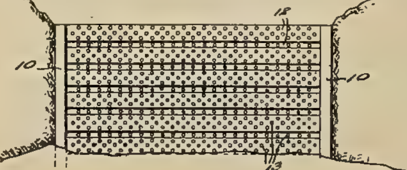
An electric furnace comprising a chamber for the passage of air to be heated, air-heating means embodying a plate



composed of heat-radiating material arranged at the top of the chamber and having on its under side electric heating means for generating and radiating heat downwardly to heat the air in the chamber, and a dome arranged above the plate to receive and distribute the heated air from the chamber.

1,215,781. **Fish-Stop.** Frank H. Davis, Eugene, Ore.

A ditch guard comprising posts provided with set or vertically extending grooves, baffle plates positioned in one set of grooves in superposed relation and provided with openings forming passageways, baffle plates positioned in the second set of grooves in superposed relation and in staggered



relation to the first set of baffle plates and provided with openings forming passageways, and legs extending from each baffle plate to engage the next lower plate and hold the plates of each set in spaced relation.

LATEST IN EVERYTHING ELECTRICAL

(The latest in everything electrical since the last date of publication is the announcement of the consolidation of the McGraw and Hill Publishing Companies given below. New apparatus comes in for its share of discussion in the way of fan motors for the coming summer, and the electrically operated sewing machine. Other interesting items also may be noted in the following pages.—The Editor.)

TYPICAL FANS FOR SUMMER

The early approach of summer sunshine on the Pacific Coast brings visions of possible future uses for the electric fan. Here are typical designs that may be obtained on the market. Most of the types listed are practically identical with those of last season, only such changes as engineering experience has shown advisable having been made.

The 9 in. fans were especially designed to meet the demands of those who consider the 8 in. fan too small for effective service.

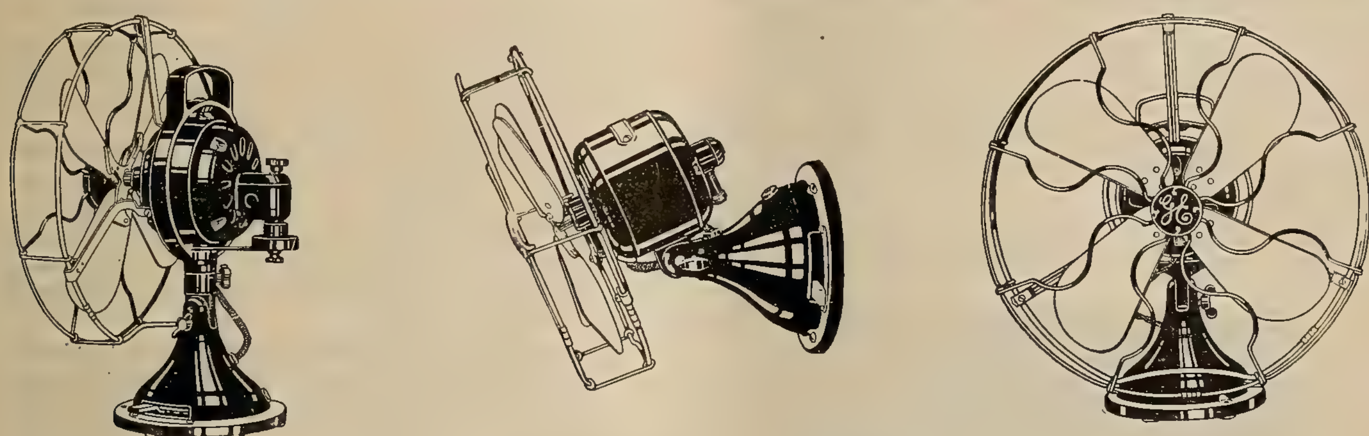
All 9 in., 12 in. and 16 in. fans are arranged for two or three operating speeds with "off" position. The control switch, which is mounted in the base, is of the improved lever design with notched guide, insuring a positive setting for each speed.

Non-Oscillating Electric Fans.—The 12 in. and 16 in. designs have swivel and hinge joint mounting, permitting the movement of the fan horizontally or vertically through a wide angle. The ease of conversion from desk to bracket type is a notable feature. This type of fan is extremely popular because of its universal adjustments. The 9 in. fans have a hinged mounting only; the swivel feature is omitted because of the extreme lightness of the fan.

Oscillating Electric Fans.—The reduction mechanism of the oscillating fan is enclosed in a dustproof cast iron box mounted on the rear cap. The crank disk operated by the slow speed shaft, which projects through the lower section of the gear box, carries the connecting rod. This rod swings at one end upon a stud fastened to the stationary support and at the other end upon a crank pin, which is adjustable with relation to the center of the crank disk.

The upper adjusting nut, which throws the oscillator "in" and out," and the lower adjusting nut, which changes the arc of oscillation, are easily actuated while the fan is in operation, and each produces a definite result. An additional adjustment in the pedestal permits swiveling the ring mounting for fan body and therefore the center of oscillation within a range of 90 deg. Thus the oscillator, having a maximum stroke of 90 deg., and a swivel adjustment of 90 deg., may be adjusted to any point within an arc of 180 deg.

Residence Fans.—The residence fan is designed for extreme quietness in running. It differs from the corresponding standard designs only in having a slow-speed operating characteristic and a 6-blade fan. This type of fan has a wide field of usefulness in residences, hospitals, offices, theaters, etc.

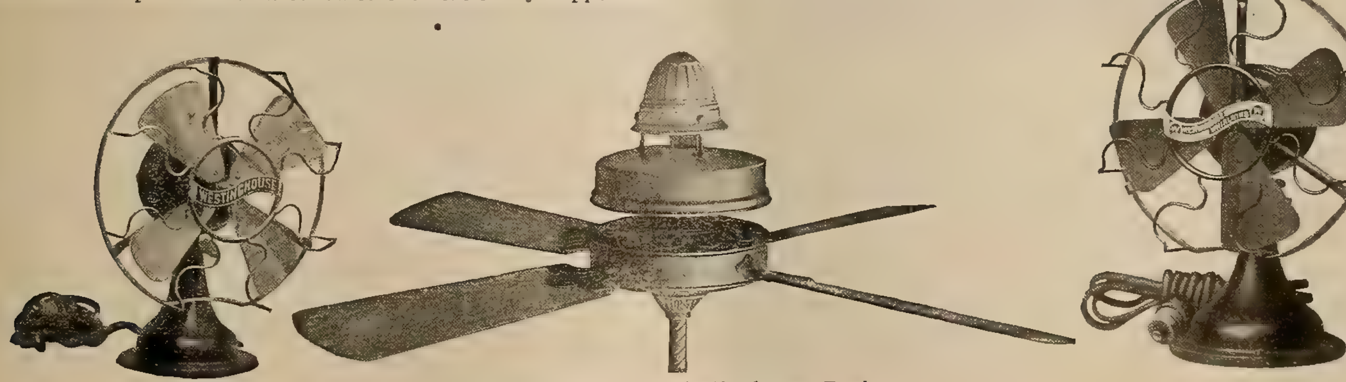


Typical Fans of General Electric Design

Ventilating Outfits.—The necessity of ventilation in small apartments is often greater than in large ones, hence the demand for the 12 in. and 16 in. exhaust fans. These are easily installed, and are durable and efficient. They are adapted to small industrial establishments, restaurants, grill rooms, kitchens, laboratories, lavatories, vaults, etc.

Ceiling Fans.—The ceiling fan is universally employed in locations where the moving of a very large volume of air at a moderate velocity is desired. It is suitable for large offices, stores, restaurants and theaters.

Ornamental type ceiling fans will no longer be carried as standard.



Typical Fans of Westinghouse Design

McGRAW AND HILL PUBLISHING COMPANIES CONSOLIDATE

The McGraw Publishing Company, Inc., and the Hill Publishing Company, New York, have been consolidated as the McGraw-Hill Publishing Company, Inc. The new company acquires all the properties and interests of the two constituents, including the following technical journals.

Electrical World, Electrical Railway Journal, Electrical Merchandising, Engineering Record, Metallurgical and Chemical Engineering, the Contractor, American Machinist, Power, Engineering News, Engineering and Mining Journal, and Coal Age.

Two of these papers, Engineering News and Engineering Record will be consolidated under the name, Engineering News-Record, with Mr. Charles Whiting Baker, now editor of Engineering News, as editor-in-chief.

Mr. James H. McGraw will be president of the new company, Mr. Arthur J. Baldwin (now president of the Hill Publishing Company), vice-president and treasurer, and Mr. E. J. Mehren, vice-president and general manager.

NEW WESTINGHOUSE SEW-MOTOR

The sewing machine was one of the first household appliances to be equipped with an electric motor. The first motors employed were just the ordinary type, but later designs have resulted in the development of a motor, having necessary speed control, for use solely on sewing machines, and the efficiency and operating features of such motors have been greatly improved.

The latest and most desirable features are to be found in the Sew-Motor shown in the accompanying illustrations, which has just been placed on the market by the Westinghouse Electric & Manufacturing Company.

The New Westinghouse Sew-Motor

The Sew-Motor can be readily attached to any make of stationary or drop-head sewing machines, new or old, with the exception of a few obsolete models. When not in use, the motor if mounted on a stationary head machine, can be pushed back out of the way and the cover put on, or dropped from the head if used on modern types of drop-head machines. When desired, however, the motor can be removed readily by loosening one thumb screw as it is light and portable.

NEW BULLETINS

The recommendations of the electrical committee of the National Fire Protection Association, at its twenty-first annual meeting, covering thirty-one pages of matter, are now available in published form.

The Locke Insulator Manufacturing Company has just issued supplement No. 1 to the beautifully engraved Insulator Book which made its appearance to the trade some months back. The supplement contains ten designs of insulators for voltages ranging from 27,000 to 80,000.

ERRATA IN NOTICE FOR NEW POWER FACTOR CALCULATOR

In the March 1st issue of the Journal, an article and a cut of a new power factor calculator by Messrs. Backstrand and Hoag of Riverside was shown. An error was made in that the device was called a power factor meter instead of a power factor calculator. The device is a calculator and not a meter.

TRADE NOTES

The Wagner Electric Manufacturing Company has combined its Los Angeles sales office and service station in new and larger quarters at No. 1320 South Grand avenue. The organization will as heretofore be under the jurisdiction of the San Francisco office, with Mr. H. W. Doubrava as local representative in charge of both sales and service.

The Moloney Electric Company of St. Louis has completed an addition to its present plant. This addition is just twice as large as its old factory, and in addition to this it has another factory at St. Louis which contains three times as much floor space as the old factory. In all the present floor space occupied for the exclusive building of transformers amounts to 128,000 sq. ft.

The many friends of Mr. Charles J. Marsh will be pleased to learn that at the January meeting of the board of directors of the Standard Underground Cable Company he was elected a vice-president of the company. Mr. Marsh is a brother of Mr. Joseph W. Marsh, president of the company. He has for many years been manager of the Eastern and Northeastern sales departments and also principal Eastern metal buyer, with headquarters in New York, and this promotion is a well-earned reward for faithful and meritorious service. He will continue to have his headquarters in New York and to exercise general supervision over the sales territory in which his genial character and native ability have won him and his company so many friends.

CALIFORNIA STATE CIVIL SERVICE COMMISSION

The California State Civil Service Commission announces an examination for mechanical inspector, State Department of Engineering, to be held in Sacramento, San Francisco and Los Angeles, March 24, 1917, to provide a register of eligibles from which to fill positions with the State Department of Engineering. The salary range is from $150 to $200 a month. The duties of the position include the supervision of either contract or day labor work on heating, ventilating, plumbing and similar work in building construction.

UNITED STATES CIVIL SERVICE EXAMINATION

The United States Civil Service Commission announces an open competitive examination for mechanical engineer, qualified as inspector of gauges, for men only. A vacancy at the Frankford Arsenal, Philadelphia, Pa., at an entrance salary of $2000 to $2400 a year, and future vacancies requiring similar qualifications will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

NEW ELECTRICAL DEVELOPMENTS

(The most interesting and important items of the past two-week period in new electrical developments are to be found in the financial statements below. The statement of the Pacific Gas & Electric Company showing that dividends have been earned on the preferred stock more than three times over with a margin of safety of nearly three millions is indicative of the splendid financial status of Western power companies. Other items of interest in electrical development follow.—The Editor.)

FINANCIAL

SAN FRANCISCO, CAL.—The Coast Counties Gas & Electric Company has reported to the National City Company for the year 1916, showing a surplus of $88,385 on the $61,000 first preferred, this being at the rate of 8.47 per cent on the $1,000,000 second preferred. The detailed statement compares as follows:

	1916.	1915.
Gross earnings	$361,408	$338,210
Operating expense, maintenance and tax	196,407	175,001
Net income	168,001	163,209
Bond interest	67,622	68,542
Deb. and other interest	11,994	15,466
Balance	88,385	79,201

SAN FRANCISCO, CAL.—The Great Western Power Company shows latest earnings, gross, $4,069,989; net $2,739,-943; bond interest, $1,290,202; debenture interest, $300,000; guaranteed dividends, $150,000. In 1914 the gross was $2,-888,940 and the net $2,015,177; in 1915 the gross $3,244,537 and net $2,289,198. Few companies in the United States are experiencing a more rapid and healthy growth. Among the underlying and subsidiary bonds outstanding are City Electric Company 5s, quoted around 90; California Electric Generating 5s, around 90; Central Oakland L. & P. 5s, around 90; Consumers' L. & P. 6s, around 100; Cons. Elec. 5s, around 79. All these issues are either assumed or guaranteed by the Great Western Power.

LOS ANGELES, CAL.—A meeting of the stockholders of the San Joaquin Light & Power Corporation, will be held April 20th, at the office of the corporation, room 805 Garland Building, for the object and purpose of determining whether additional bonded indebtedness in the sum of $4,500,000 shall be created by the issuance of its debentures to that amount to provide money to be used for new construction forming part of the corporation's system, additions, betterments and extensions, etc. Said debentures are to bear interest at a rate not exceeding 6 per cent per annum, payable semi-annually or quarterly, as may be determined by the stockholders' meeting or by the board of directors of the corporation. This notice is given by the direction of the board of directors of the San Joaquin Light & Power Corporation.

SAN FRANCISCO, CAL.—During the year 1916 the Pacific Gas & Electric Company, earned a surplus of $4,272,343 after the payment of all operating expenses and taxes, and setting aside $2,603,115 for maintenance, depreciation, uncollectable accounts, and for other contingencies. Dividends on the company's preferred stock, having the first claim on this surplus, amounted to $1,390,257, indicating that these dividends were earned more than three times with a margin of safety of $2,882,086. In the month of January, 1917, the company made a net gain of 1355 customers, and at the close of that month was serving 423,149 consumers. The magnitude of this list of customers may be appreciated from the fact that it exceeds the population at the 1910 census of each of ten States.

INCORPORATIONS

RENO, NEV.—Western Gas & Power Company, Reno, $1,000,000, shares $100 each, by C. S. S. Forney B. F. Silverstein, C. J. Parks, A. L. Erb and Lon Claybaugh, all of San Francisco.

ILLUMINATION

SAN DIEGO, CAL.—Machinery has been received here for the installation of the Ensenada electric lighting plant.

ORANGE, CAL.—The Merchants' & Manufacturers' Association is taking an interest in getting ornamental lighting system for the city.

FILLMORE, CAL.—It is probable that the main business block in Central avenue will be illuminated soon by ornamental lights.

HUNTINGTON BEACH, CAL.—At a session of the city trustees the petition of property owners asking for the installation of gas lights on Main street was granted.

SAWTELLE, CAL.—Bids for supplying and furnishing the city of Beverly Hills with 312 ornamental concrete lighting standards are being received by the city clerk.

ST. JOHNS, ARIZ.—Thos. W. Carraway has the contract for putting in the power plant for the Nebo Electric Light & Power Company. Work will be started at once.

HELIX, ORE.—At the meeting of the new council board, a committee was appointed to investigate the feasibility of putting in a municipal water plant in connection with the water system.

TACOMA, WASH.—The Home Electric Company has been given the contract to furnish the city light department with 18,000 lbs. of No. 6 copper wire and 1000 lbs of No. 10. The price is $9097.

LOS ANGELES, CAL.—The request for furnishing equipment for the Graham Lighting District through the county mechanical department, has been granted by the board of supervisors.

MIAMI, ARIZ.—The Union Electric Company, doing a general electrical contracting business, has opened offices at the Lenord Music Company. G. L. Lenord and Reid Clark are members of the firm.

LOS ANGELES, CAL.—An order has been made by the board of supervisors requesting the chief mechanical engineer to prepare specifications for the installation of a lighting system in Athens Lighting District.

MARSHFIELD, ORE.—J. H. Levers is taking steps to secure for the city of Marshfield a municipal electric plant. His plan is to petition a call for an election to decide upon bonding the city for such a plant.

TUCSON, ARIZ.—Plans for the camp at the Stratton property include the building of a concrete reservoir. The machinery for developing the property will consist of compressor, boiler and an electric light plant.

MODESTO, CAL.—Bids will be received by the county clerk up to March 13th for furnishing necessary lamps, appliances and electricity required for lighting streets by means of 100 candlepower to be installed on certain streets.

ARCADIA, CAL.—The board of supervisors have decided to light First avenue from the Santa Fe railroad right of way to Anite avenue, by installation of 14 reinforced concrete ornamental street lighting standards, wires, lamps, etc.

VALLE VISTA, CAL.—The commercial agent of the Southern Sierras Power Company has been here in reference to the proposed extension of the distribution system for lighting purposes along Florida avenue, from the end of the present line to Valle Vista.

LOS ANGELES, CAL.—At a meeting of the city council a petition was received from Stevens-Turner Company asking that an ornamental lighting system be installed on Sierra Bonita avenue, between Hawthorne avenue and Sunset boulevard.

CASA GRANDE, ARIZ.—The city council has awarded the contract for building the municipal water and electric light system to the Schweitzer Machine Company of Tucson, on a bid of $25,029. Construction work will commence as soon as possible.

TOMBSTONE, ARIZ.—The city council has extended the franchise to E. L. Wright for an electric light plant at Tombstone on petition of J. M. Downey, who will immediately take steps for the erection of a $15,000 plant. Street lights will also be installed in the business district.

ROSEBURG, ORE.—Harry Gall, manager of the Douglas County Water & Light Company announced that work will begin soon on the erection of a concrete office building for the company. Plans for the building are completed and the contract for the construction will be let.

ALBANY, ORE.—The city council has passed a resolution asking the Oregon Power Company for a price on the water and light system owned in Albany, to be submitted not later than April 1. A committee from the council will go to Eugene to inspect and investigate the municipal plants there.

NORTH YAKIMA, WASH.—Application by the Pacific Power & Light Company for a 50-year franchise from the county for the erection of an electric pole line along the county roads in the vicinity of Granger has been presented to the county commissioners. No date has been set for further action.

LOS ANGELES, CAL.—Application has been made by the Beverly Hills Utilities Company to the board of trustees of Beverly Hills for the granting of a franchise to lay, maintain and operate a system of pipes and pipe lines in, under and along public streets, etc, of the city for the purpose of supplying gas.

SANTA BARBARA, CAL.—The lighting of State street, which is now assured from the beach to Sola street, should be extended along upper State street and De la Vina street, to the city limits and Garden and Los Olivos streets to the Mission, according to sentiment expressed at a meeting of the Commercial Club.

SOUTH PASADENA, CAL.—Indications are that work will begin soon on installing the ornamental lighting system on Mission street, from Fair Oaks to Meridian avenue. The contract, which was let to the Arizona-California Construction Company, which has gone bankrupt, has been turned over to the Jacobs Electric Company of this city.

NOGALES, ARIZ.—At a meeting of the Chamber of Commerce a committee was appointed to investigate and report back on the plan for street lighting, to be recommended to the town council for adoption. A plan has been submitted by the International Gas Company to light Grand avenue, Park street and Court street and Morley avenue.

YUMA, ARIZ.—Application has been made to the board of supervisors by Chas. H. Hosfold for a franchise to build, operate and maintain an electric light plant and build electric pole lines along, over and across public streets and alleys within the limits of the town of Parker. It is the intention of the Board to grant the franchise at the meeting of March 5th.

BAKERSFIELD, CAL.—The city council has instructed the city engineer to prepare plans and specifications for the installing of an electrolier lighting system along Chester avenue, between Fifteenth and Twentieth, and along Nineteenth, between M and F streets. The engineer's plans will provide for the installation of four 500 candlepower electroliers to the block on each side of the street.

TACOMA, WASH.—Five bids for $20,000 worth of incandescent electric lamps were referred to the council by the electric department because the bids were all alike. The bids were from the North Coast Electric Company, the General Electric Company, Western Electric Company, Fobes Supply Company, and the Home Electric Company. The council referred the matter back to the superintendent of the electric department and instructed him to use his own judgment.

RICHMOND, CAL.—The Merchants' Association of this city has started a campaign to have electroliers established in the business district. At a well attended meeting President Harry W. Pulse outlined the plan, which was unanimously indorsed and a committee consisting of C. M. Brewer, O. R. Ludewig, W. L. Ballemger, D. J. Collins, Charles J. Crary and President Pulse was appointed to figure out the plans with the city council.

TRANSMISSION

VACAVILLE, CAL.—The Vallejo Electric Light & Power Company has filed application for a franchise to erect and maintain power lines along certain public roads in Solano County. Bids will be received for the franchise until April 2.

RENO, NEV.—An electric generating plant developing 2500 h.p. will be constructed a short distance below Vista on the Truckee River as soon as the weather permits, according to plans that have been perfected by the Nevada Valleys Power Company.

HANFORD, CAL.—An ordinance has been passed granting the Mt. Whitney Power & Electric Company a 50-year franchise allowing it to construct and operate an electric light, heat and power system in Kings County. There was no other bidder for the franchise.

OAKDALE, CAL.—The Sierra & San Francisco Power Company is providing light and power for the plants of the Valley Ice Cream and the Borden Condensed Milk Company of Modesto. In the plans outlined by the company for improvement of its lines, is an appropriation of $10,000 for a plant to be erected at Oakdale.

LOS ANGELES, CAL.—To furnish the energy for the great mining projects of three states and eventually electricize the Santa Fe railroad, details for the building of a huge power dam in the Grand Canyon of the Colorado are completed. The plant is expected to furnish hydro-power for less than $4 per h.p. a month.

TELEPHONE AND TELEGRAPH

EUGENE, ORE.—The Postal Telegraph & Cable Company is asking the council for a franchise to operate in the city.

TOMBSTONE, ARIZ.—A new telephone system will be built at Johnson by the Mountain States Telephone & Telegraph Company.

COURTLAND, ARIZ.—District Manager Evans of the Mountain States Telephone Company has been here planning improvements in the local system of lines.

EUGENE, ORE.—The Pacific Telephone & Telegraph Company sent a crew of men to the coast to run a 24 mile 132 lb. double copper wire from Cushman to Gardiner. The new toll line will connect with the main wire running from Eugene to Florence.

YUMA, ARIZ.—It has become known that officials of the Mountain States Telephone & Telegraph Company have approved plans, estimates and specifications for the installation of telephone lines throughout Yuma Valley, and that as soon as the general manager at Denver signs the papers the work of construction will be commenced. The company has appropriated $25,000 for this enterprise. It includes the establishment of an exchange at Somerton.

Devoted to the Generation, Distribution and Utilization of Energy

JOURNAL OF ELECTRICITY

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Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII | SAN FRANCISCO, APRIL 1, 1917 | NUMBER 7

RIVERSIDE—AN INSPIRATION FOR ELECTRICAL MEN

(The charm of Western daring and tradition pervades the very atmosphere at Riverside, where is soon to gather an unprecedented number of men of the electrical industry in the West. Riverside, the home of the Glenwood Inn, renowned for its beauty and comfort of setting and the center of the Southern Sierras Power Company, with its six hundred and fifty-four miles of pulsating energy, stretching from Wonder, Nevada, through eastern California to Yuma, Arizona, presents an atmosphere in full keeping for the convention gathering of the Pacific Coast Section of the National Electric Light Association, April 19, 20, 21, 1917. There are times when pictures portray more than words can possibly describe. In issues of the Journal of July 5, 1913, July 12, 1913, November 25, 1916, and December 23, 1916, the various accomplishments and installations of the Southern Sierras Power Company have been fully described. In the following pages may be found a story in pictures that sets forth the wonders of Riverside and the achievements of this remarkable company as they will be explained to guests and visiting members at the convention.—The Editor.)

THE STRIKING OUTLOOK FROM RUBIDOUX HILL

Here is a scene with its rugged contour in the foreground, with its citrus fruits displayed in all directions, and with its crown of snow-capped mountains in the distance that almost overcomes the onlooker in contemplating the wonders that "God hath wrought" in the creation of an empire so vast, so impressive in configuration, and so abounding in possibility for the work of man, equipped with the all-conquering force—that wonder of modern accomplishment—electricity.

THE GLENWOOD INN

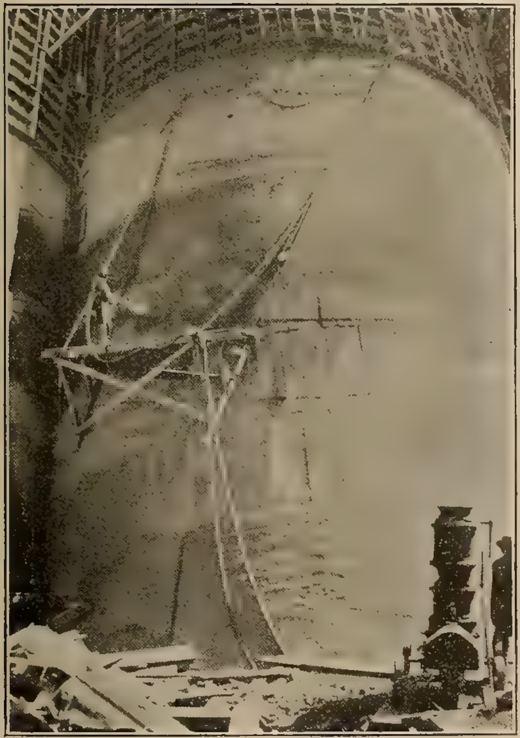
In full keeping with traditions of the Spanish main and early California romance, this monument of hospitality will greet with open doors the guests and members of the approaching convention.

HOME COMFORT AT THE GLENWOOD

The wives, sweethearts, daughters and friends of convention members will find every want provided for in these luxurious apartments.

THE GEM LAKE DAM OF THE RUSH CREEK DEVELOPMENT

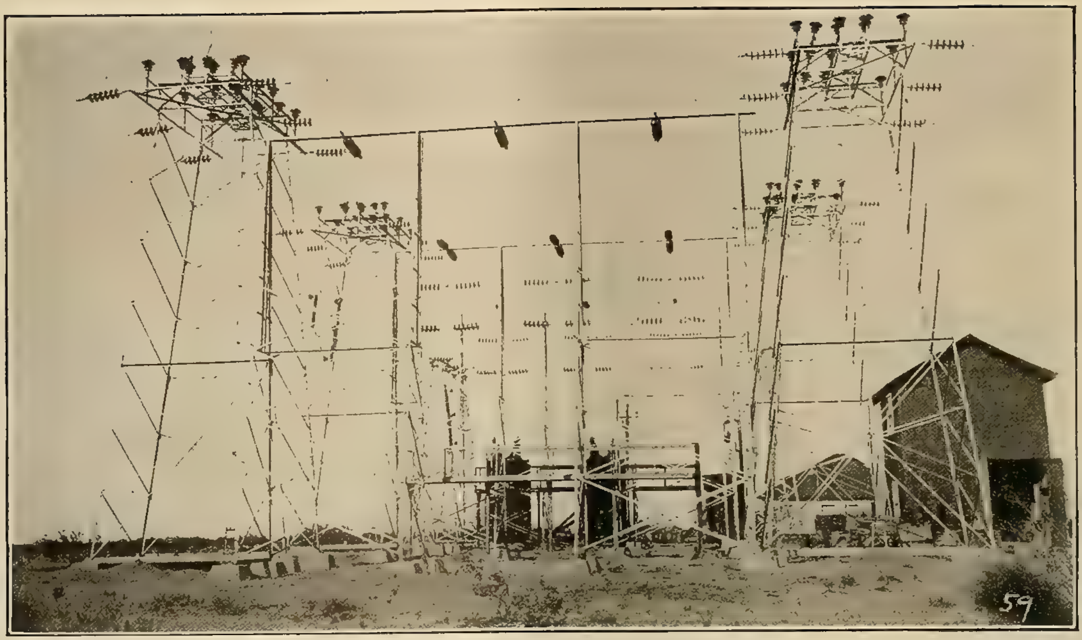
In these snow-clad mountains the water wheels of the Southern Sierras Power Company start the pulsating electrical energy on its world-beating distance of transmission of five hundred and thirty miles.

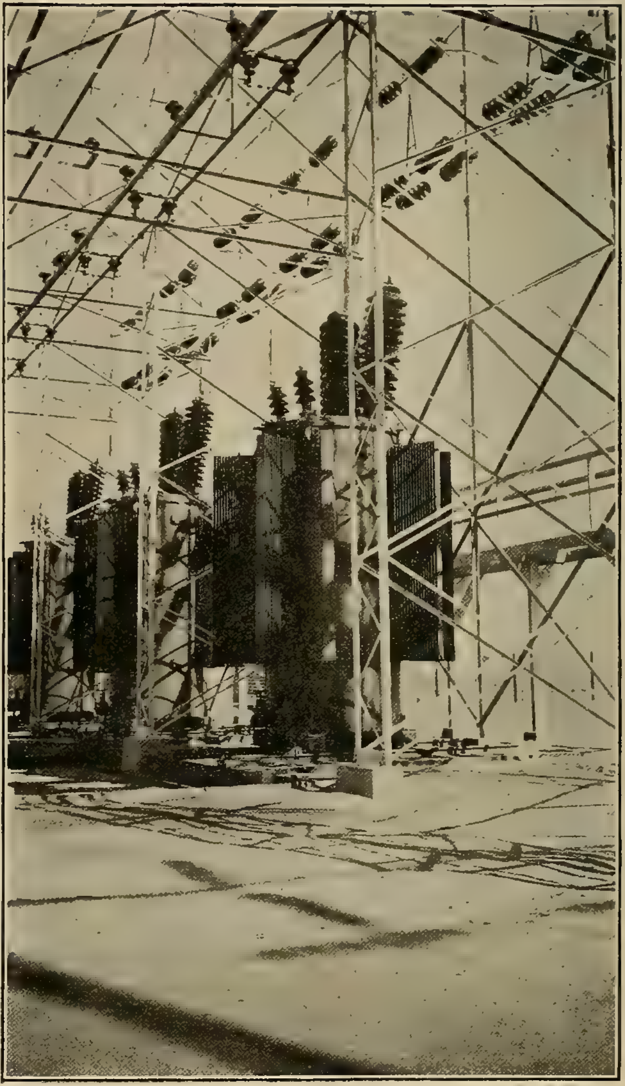


THE CEMENT GUN

HIGH TENSION LINES AND THE MULTIPLE ARCH DAM

In the high Sierras the last word in engineering skill and design has been employed to make for efficiency and low cost of production.





THE INYO SUBSTATION AND THE NEW RADIATOR TYPE OF TRANSFORMER AT THE VICTORVILLE SUBSTATION

The Southern Sierras Power Company is one of the group of associated companies operating in the east and south of California and Western Nevada. These companies obtain their power from Bishop, Rush and Mill Creeks, all of which creeks are on the eastern slopes of the Sierra Nevada Mountains. On each stream are located large reservoirs for equating the flow. There are now in operation seven hydroelectric power lines, all of which are of concrete steel construction, with outdoor type step up transformer stations. Pelton impulse water wheels are used in all plants, on account of the high heads, which vary from 400 to 1900 ft. The combined capacity of all plants is 45,000 kw. As an auxiliary to the hydroelectric plants there is a steam turbine plant located at San Bernardino, which is capable of supplying 8000 kw.

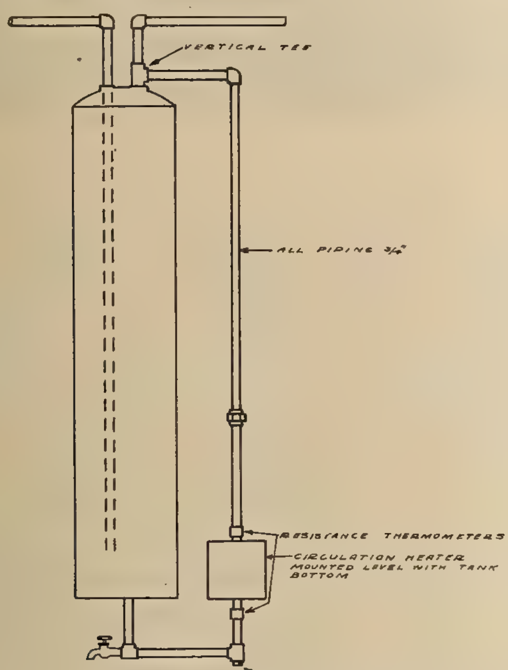
Connecting San Bernardino and the hydroelectric plant on Bishop Creek is a steel tower line 238 miles long, carrying two 3-phase circuits, the cable used being composed of 6 strands of aluminum with a center strand of steel. All main transmission substations are of the outdoor type. The total mileage of transmission line is 975 miles, connecting to which are 858 miles of distribution lines. The distance from Wonder, Nevada through Bodie to Bishop to San Bernardino to El Centro and ending at Yuma is 654 miles, and from the generating plant on Rush Creek to the end of the transmission line at Yuma, a distance of 530 miles, the greatest distance ever attempted in the history of electrical engineering.

EXHAUSTIVE TESTS ON ELECTRIC WATER HEATERS

BY STANLEY V. WALTON

(Heating water by electricity has received an immense impetus due to its importance and value in connection with the electric range. Exact data concerning performance tests upon various types of electric water heaters have long been lacking. Here is an article on this subject containing a summary of tests on electric water heaters that have recently been made in the testing laboratory of the Pacific Gas & Electric Company. The Commercial Committee of the Pacific Coast Section of the N. E. L. A. has prepared this paper for consideration at the Riverside Convention, April 19, 20, 21.—The Editor.)

In the following pages are summarized reports of tests made on electric water heaters and on heat losses from boilers and water pipes, bare and insulated. Every effort has been made to condense as much as possible and to include only such descriptive and explanatory matter as will make the report intelligible



Standard Connections for Testing Circulation Type of Water Heaters

For further information, reference must be made to the original detailed reports.

In testing circulation type heaters the method employed was that given in the 1916 report of the N. E. L. A. Electric Range Committee, under the heading, "Standard Test for Electric Water Heaters." As a large portion of this reports covers the circulation heater and as a statement of connections and test method is necessary in order that the report may be made intelligible, they are here explained in detail.

Standard Test for Electric Water Heaters, Circulation Type

Purpose.—The object is to obtain comparative data on electric water heaters that will be independent of external influences, such as the size of boiler and piping, use or absence of thermal insulation, location of heater and surrounding temperature.

Connection.—All circulation type heaters were connected for test as shown in the above illustration, entitled "Standard Connection for Testing Circulation Type Water Heaters." The boiler was of nominal 30 gal. size, uninsulated. Piping was ¾ in., except where otherwise specified. Valves in cold and hot water pipes leading to and from the boiler were closed. Electrical resistance thermometers in direct contact with the water were placed close to and on each side of the heater. They were mounted in ¾ in. pipe nipples and consisted of copper coils wound on brass tubing.

Routine of Test.—The following data were obtained:

1. Power input on alternating current, hot and cold, at rated voltage.
2. Temperature head and rate of flow.
3. Surface temperature.
4. Losses and efficiency.
5. Insulation resistance, hot and cold.
6. Galvanic e.m.f.
7. Dry test for durability.

Remarks

1. Due to an appreciable temperature coefficient, of the resistance wire, the power input when cold and hot water respectively is entering the heater, is not the same for all makes of heater tested, but no important variation was discovered.

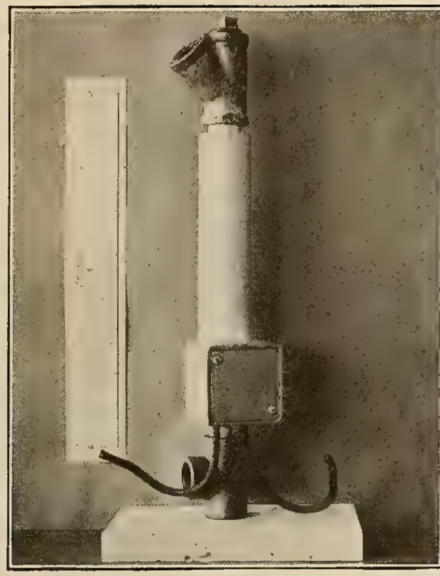
2. By temperature head is meant the temperature difference between incoming and outgoing water. The temperature head and rate of flow are dependent in every case upon kilowatt capacity of heater and resistance of heater passages and connections. In these tests the numerical values apply only to this particular installation, but are believed to give a reasonable idea of what to expect under similar conditions. They emphasize the necessity, borne out by practical experience, of throttling the circulation passage in order to introduce water at the top of the boiler at a sufficiently high temperature.

Rate of flow is calculated from the temperature head, kilowatt input to heater and heater efficiency as follows:

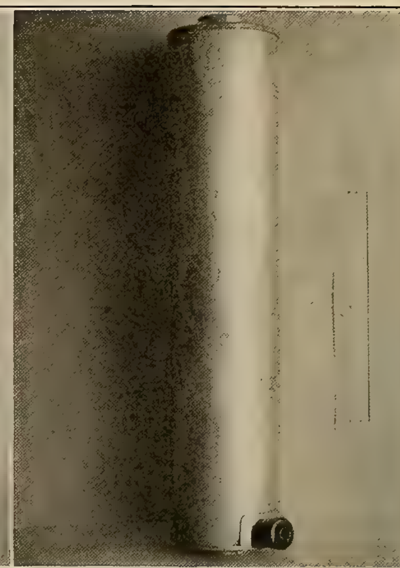
Let T = temperature head in degs., Centigrade.
W = kilowatt input to heater.
E = heater efficiency.
V = rate of flow in gallons per hour.

$$\text{Then } V = \frac{227.3\ W\ E}{T}$$

3. By surface temperature is meant the external temperature of heater as furnished by the manufacturer, ready for connection. If a lagged heater is supplied, the temperature will be that at the outside surface of the insulation. In these tests it was determined by an electrical contact pyrometer. Surface temperature determines the radiation loss and is of further importance to those who may come in contact with the heater when in use.


General Electric


Good Housekeeping


Curan

4. Losses occur only by radiation, by air convection currents and by conduction along piping with subsequent radiation. These losses are approximately determined, if, with heater disconnected and water passages plugged, energy is applied at a rate that will maintain the same average surface temperature as found on test. The input to water and corresponding efficiency are found by subtracting the losses from the total input to heater.

5. In these tests efficiency was found in this manner. In stating the efficiency of any heater it is necessary to specify also the corresponding temperature of boiler water, because with cold water entering the heater all temperatures and losses will be lower than with hot water entering. With some of the low capacity heaters tested it was impossible to obtain a boiler temperature higher than 60° C. because the entire capacity of the heater was required to maintain the radiation loss at that temperature.


The Coin Machine Company Heater

6. The galvanic e.m.f., as an indicator of possible electrolytic corrosion, was determined between different metals of the heater and between the heater and galvanized iron pipe, using San Francisco tap water as the electrolyte. Copper coils of gas heaters have been connected to iron pipes for many years without serious trouble from this cause, and there is therefore little reason to expect electric heaters to suffer therefrom.

7. The dry test is an indication of the heater's ability to operate without burning out after the deposition of scale or if current is turned on when the tank has been drained of water. This test was made only on heaters of rugged construction, as experience has demonstrated that others, paricularly with bayonet type elements, will burn out when coated with scale.

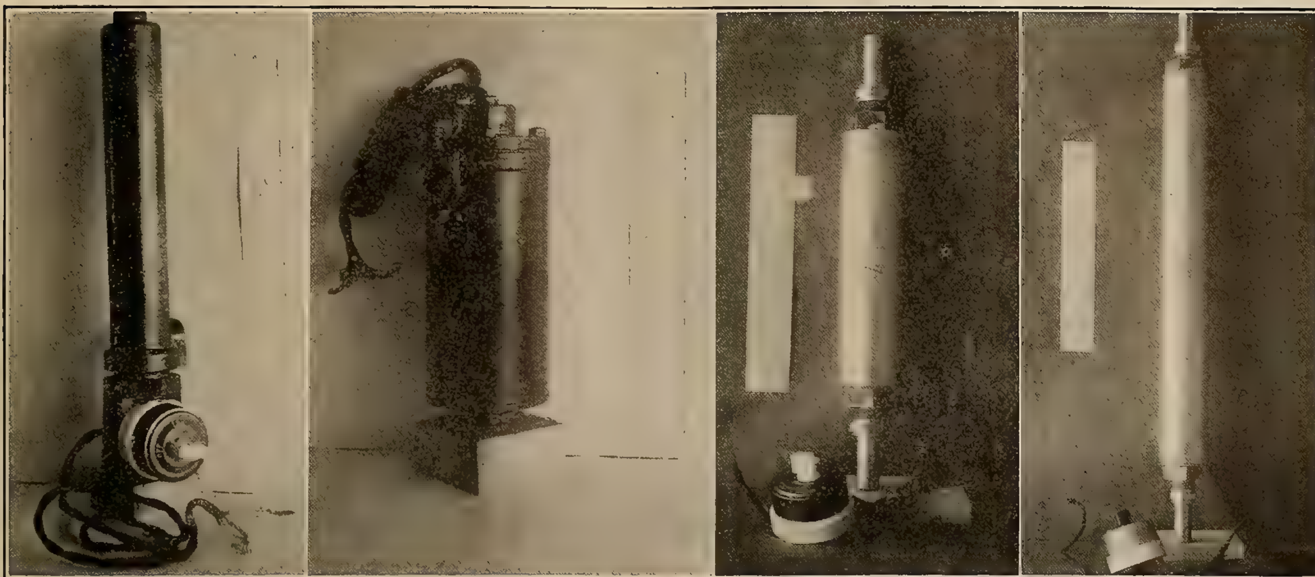
The tests reported herein were made in the laboratory of the Pacific Gas & Electric Company during 1915 and 1916 under the auspices of the Water Heating Committee of the 1916 Electric Range Committee of the National Electric Light Association.

General Electric Company

Date Tested—August 29, 1916.
Type—L-59, Circulation. Non-automatic.
Volts—110.
Watts—700.
Heat—Single.
Overall Dimensions—3½ in. by 2¾ in. by 16 in.
Weight—4.75 lb.
Construction—Copper tube wound with metal sheathed nichrome wire encased in a cast aluminum jacket. Heat flow is radially inward to water and outward to air.
Insulation—None.
Facilities for Cleaning—Excellent; see photo. By removing plugs at either end heater can readily be cleaned without disconnecting.

Test

Connections and Method—Standard.
Temperature Head—12° C. at start; 8.5° C. after 6 hours.
Circulation—12.2 gal. per hr. at start; 14.2 gal. per hr. after 6 hrs.
Losses—43 watts at start; 114 watts after 46 hrs.
Efficiency—94% at start; 82% after 46 hrs.
Watts Input—At constant voltage of 110 applied the input decreased from 725 to 685 watts in the first hour with cold water in the boiler and then slowly dropped to 645 watts after 46 hours.
Insulation Resistance—Cold = 1000 megohms; hot = 76megohms.
Galvanic E.M.F.—.4 volt, copper tube to galv. iron pipe.



Hughes Style 84 — Hughes Style 81 — Simplex Type T-426 — Simplex Type T-422

Durability—The heater was disconnected from the boiler and connected directly across a line e.m.f. of 120 volts. It assumed a dull red heat after about 10 minutes and remained at this temperature with current on for approximately an hour. Upon cooling to room temperature the heater showed no signs of deterioration and the resistance was the same as before the test.

Remarks—This heater has an unusually low efficiency, due apparently to the use of a fine resistance wire which is forced to operate at too high a temperature.

The bimetallic construction of an aluminum jacket cast around a copper tube has been abandoned in favor of a single homogeneous casting.

Coin Machine Manufacturing Company

Date Tested—January 21, 1916.
Type—Induction: Two heaters, No. 35B-109 S. C., No. 35A-55.
Volts—110.
Amperes—11 and 8.5. 1000 and 750 watt nominal.
Heat—Single.
Overall Dimensions—9 in. by 7.75 in. by 6.25 in.
Weight—26 lb.
Construction—A structure consisting of a copper coil with hollow core of cast iron or steel and laminated iron yokes, arranged somewhat in the order of a shell type transformer. When the coil is connected to the proper alternating current supply, eddy currents are set up in the core, which will heat water in contact therewith. The coil is wound with asbestos insulated wire, and is protected by an external cast iron shell. Water comes in direct contact with heating element. Heat flow is radially inward to water and outward to air along good conducting paths of metal.

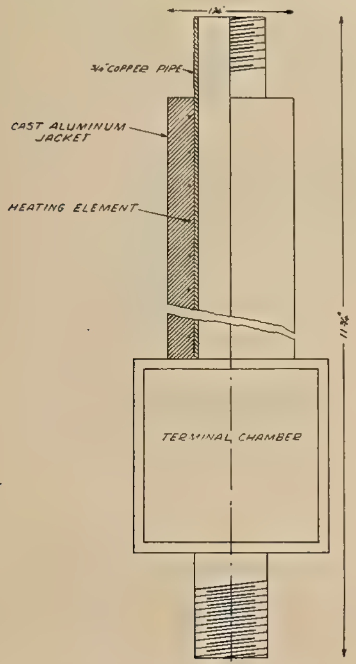
Insulation—None.
Facilities for Cleaning—None, unless piped with special tees. Otherwise heater must be disconnected.

Test

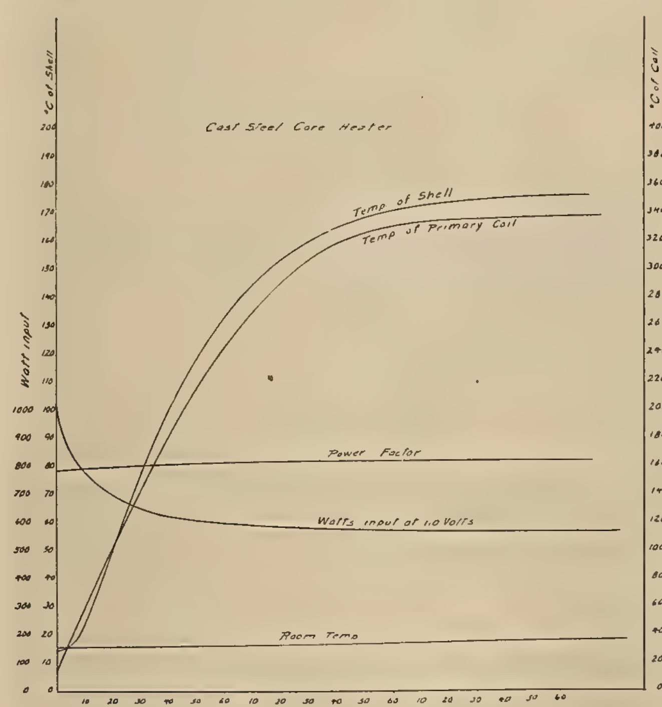
Connections and Method—Standard, ½ in. circulating pipe.
Temperature Head—17° C.
Circulation—13 gal. per hr.
Efficiency—750 watt heater, 96% decreasing to 88% after 12 hrs.
1000 watt heater, 97% decreasing to 90% after 12 hrs.
Watts Input—At 110 volts, 750 watt heater, 740 to 700 watts after 12 hrs.
1000 watt heater, 1050 to 900 watts after 12 hrs.
Power Factor—At 110 volts, 750 watt heater, 77% to 74% after 12 hrs.
1000 watt heater, 79% to 80.5% after 12 hrs.
Surface Temperature—73° C. with water discharging at 64° C.
Durability—Heater stood dry test with 150 volts applied for over an hour without injury.
Remarks—The induction heater is probably the most durable of any made. Its efficiency can be increased by proper lagging. The low power factor is undesirable. In service it has been found to produce an objectionable hum that is transmitted by the piping to which it is connected.

Hughes Electric Heating Company

Date Tested—August 24, 1916.
Type—Style 84, No. 23214. Circulation, non-automatic.
Volts—110.
Amperes—6.9.
Heat—Single.



General Electric Water Heater



Characteristics of Dry Run of Induction Heater No. 35

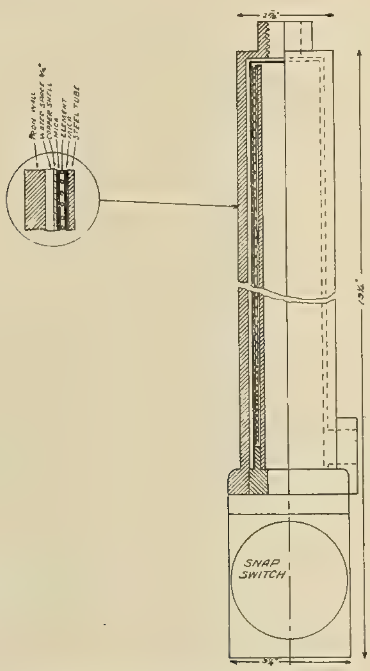
Overall Dimensions—10½ in. by 4 in. diameter.
Weight—10¼ lb.
Construction—Cast iron shell enclosing a cylindrical, bayonet type heating unit, which consists of a layer of resistance wire wound over a mica insulated metal cylinder. Over the resistance wire is placed a second layer of mica and the whole unit is covered with a copper sheath. Surrounding the cast iron shell is a light sheet iron casing, forming with the shell an annular space for placing insulating material. Heat flow is from element outward into water.
Insulation—½ in. sheet asbestos.
Facilities for Cleaning—By unscrewing the bolts shown in picture, the heating element can be removed, without disconnecting heater.

Test

Connections and Method—Standard.
Temperature Head—12° C. at start; 9.1° C. after 7 hrs.
Circulation—13 gal. per hr. at start; 19 gal. per hr. after 8 hrs.
Losses—Less than 1% after 24 hrs. with water in boiler at 55° C.
Efficiency—99% or better.
Watts Input—709 watts at 110 volts, dropping to 705 watts after 24 hrs. at constant voltage.
Maximum Surface Temperature—20° C. after 24 hrs. operation, at lower end to which heating element is attached. Room temperature 12° C.
Insulation Resistance—Cold = 900 megohms; hot = 2500 megohms.
Galvanic E.M.F.—.4 volt between iron shell and copper sheath of heating unit. Calculated current = .033 amps.
Durability—Dry test was not attempted because of understanding that heating element would soon be destroyed if current were turned on without water in the heater.

Hughes Electric Heating Company

Date Tested—August 23, 1916.
Type—Style 84, No. 23214. Circulation, non-automatic.
Volts—110.
Watts—500, 1000, 2000.
Heat—Three.

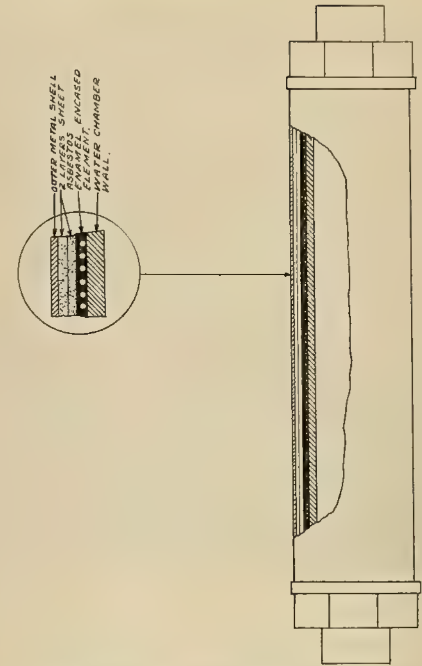


Hughes Electric Water Heater

Overall Dimensions—20 in. by 5¾ in. by 3½ in.
Weight—12.25 lb.
Construction—Bayonet type element inserted into cast iron shell. See accompanying photograph and sectional view. Heat flow is from element outward into water.
Insulation—None.
Facilities for Cleaning—Heating element may be removed without disconnecting rest of heater.

Test

Connections and Method—Standard.
Temperature Head—Low heat, 7° C.
Medium heat, 11° C.
High heat, 16° C.
Circulation (After 24 hrs.)—Low heat, 16 gal. per hr.
Medium heat, 20 gal. per hr.
High heat, 27 gal. per hr.
Efficiency—Low heat, 93% temp. of boiler water 44° C.
Medium heat, 95% temp. of boiler water 59° C.
High heat, 94% temp. of boiler water 120° C.
Watts Input at 110 Volts—Low heat, 536 watts to 528 watts after 24 hrs.
Medium heat, 1028 watts to 1007 watts after 24 hrs.
High heat, 2122 watts to 2016 watts after 24 hrs.
Insulation Resistance—Insulation failed at 600 volts.
Galvanic E.M.F.—.42 volt between iron shell and copper sheath of heating unit. Calculated current .07 ampere.
Durability—Dry test was not attempted because of understanding that heating element would soon be destroyed if current were turned on without water in the heater.



The Simplex Electric Water Heater

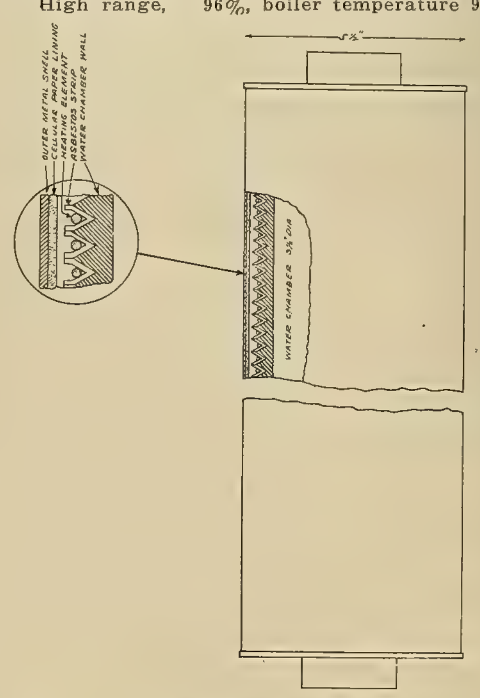
Remarks—The design of this heater inherently lends itself to high efficiency.

Simplex Electric Water Heater

Date Tested—August 28, 1916.
Type—T-426, No. 820714. Circulation; Non-automatic.
Volts—200, 250.
Amperes—13.4.
Heat—Three, 750, 1500, 3000 watts.
Overall Dimensions—32.5 in. by 3 in. diameter.
Construction—A brass tube wound on the outside with resistance wire baked on with enamel. Overall is an enclosing, nickel plated, brass shell. The diameter of water passage is 1.5 in., throttled at inlet and outlet to 7/16 in. Heat flow is radially inward to water and outward to the air.
Insulation—None.
Facilities for Cleaning—None. Heater must be disconnected from boiler or else piped with special tees.

Test

Connections and Method—Standard.
Temperature Head—Low range, 14° C.
Medium range, 21° C.
High range, 31° C.
Circulation—Low range, 12 gal. per hr.
Medium range, 15 gal. per hr.
High range, 20 gal. per hr.
Efficiency—Low range, 96%, boiler temperature 41° C. Avg.
Medium range, 94%, boiler temperature 77° C. Avg.
High range, 96%, boiler temperature 93° C. Avg.



The Curan Heater

Watts Input—After 24 hours operation at 220 volts—
Low range, 734 watts.
Medium range, 1468 watts.
High range, 2879 watts.
Maximum Surface Temperature—Low range, 49° C.
Medium range, 94° C.
High range, 122° C.

Readings were taken at end of 24-hour runs, the heater having assumed in each case its maximum temperature.

Galvanic E.M.F.—.9 volt between brass tube and galvanized iron pipe.
Durability—Dry test was not made.

Simplex Electric Water Heater

Date Tested—August 26, 1916.
Type—T-422, No. 789826 Circulation; Non-automatic.
Volts—110, 120.
Amperes—6.7.
Heat—Three, 150, 500, 700 watts.
Overall Dimensions—21.5 in. by 3 in. diameter.
Weight—Including three range snap switch = 9.1 lb.
Construction—See report on Simplex heater No. 820714 and accompanying drawing.
Insulation—Two thin layers of sheet asbestos.
Facilities for Cleaning—None. Heater must be disconnected from boiler or else piped with special tees.

Test

Connections and Method—Standard.
Temperature Head—Low range, 6 ° C.
Medium range, 12.5° C.
High range, 15 ° C.
Circulation—Low range, 6 gal. per hr.
Medium range, 8.5 gal. per hr.
High range, 10.5 gal. per hr.
Efficiency—Low range, 95% boiler temperature 29° C. Avg.
Medium range, 97% boiler temperature 40° C. Avg.
High range, 96% boiler temperature 54° C. Avg.
Watts Input—at 110 volts—Low range, 159 watts.
Medium range, 477 watts.
High range, 716 watts.
Maximum Surface Temperature—Low range, 31°.
Medium range, 44°.
High range, 59°.
Insulation Resistance—34 megohms cold and 360 megohms at operating temperature.
Galvanic E.M.F.—.9 volt between brass tube and galvanized iron pipe.
Durability—Dry test was not attempted.

Curan Heater

Date Tested—August 18, 1916.
Type—Circulation; Non-automatic.
Volts—110.
Amperes—5.5.
Heat—Single.
Overall Dimensions—26.5 in. by 5.5 in. diam.
Weight—36 lb.
Construction—A grooved, cast iron cylinder with resistance wire wound in the groove and separated from the cylinder by asbestos strip. A layer of cellular paper is placed over the resistor with an enclosing sheet iron jacket over all. The diameter of water passage is 4 inches and connections are for 1½ in. pipe. Heat flow is radially inward to water and outward to air.
Insulation—Paper.
Facilities for Cleaning—None, unless piped with special tees. Otherwise heater must be disconnected.

Test

Connections and Method—Standard.
Temperature Head—15° C. falling to 9.5° C. after 24 hours.
Circulation—12 gallons per hour, increasing to 14 g.p.h. after 24 hours.
Losses—5 watts increasing to 44 watts after 24 hours.
Efficiency—99.5% decreasing to 97.5% after 24 hours.
Watts Input—612 watts, decreasing to 588 watts after 24 hours at 110 volts.
Maximum Surface Temperature—35° C. at discharge end of heater after 47 hr. run.
Insulation Resistance—Insulation failed under 600 volts during test.
Durability—Dry test not attempted.
Remarks—This heater was designed and built in Spokane, apparently for the purpose of handling water that carries much solid matter in solution, where burnouts due to scale formation have been serious. The low wattage and large surface in contact with water mean low temperature of heating wall, also for a given quantity of water heated, the thickness of scale deposited will vary inversely with the heating surface, so that scale should deposit on this heater in a much thinner layer than on other heaters of smaller dimensions.

In spite of the large radiating surface, high efficiency is secured by low operating temperature of the heating element.

Good Housekeeping Electric Water Heater

Date Tested—August 28, 1916.
Type—Style "W," Serial No. 29. Circulation; Automatic.
Volts—110.
Watts—950.
Heat—Single.
Overall Dimensions—With cover in place, 5 in. by 8 in. by 20.75 in.
Weight—19 lb.
Construction—A heavy iron "U" tube contains in one arm a bayonet type heating element and in the other arm a thermostat consisting of an hermetically sealed tube containing a liquid of low boiling point. The vapor from this liquid operates with a strong pressure against a copper diaphragm of the "oil can" type, the motion of which is transmitted to a single pole switch in series with the heating element.

The thermostat can be adjusted to cut the current on and off at any desired temperature.

Connection should be so made that water enters on the thermostat end of the heater.

The "U" tube is enclosed in a rectangular, sheet metal case which is filled with insulating material.

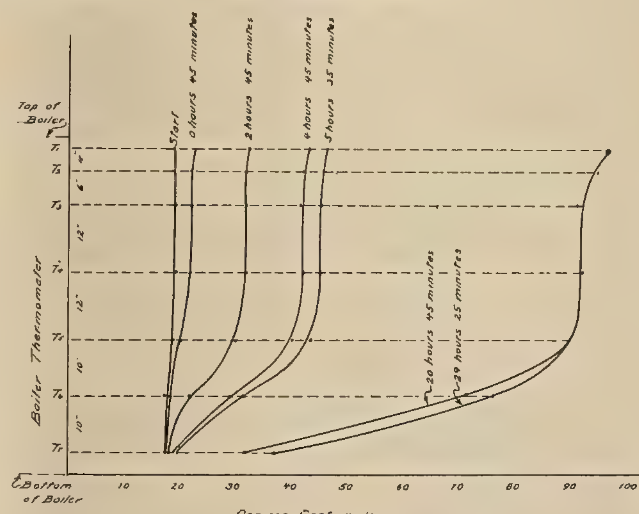
Insulation—Granulated cork, to a minimum thickness of about one inch.
Facilities for Cleaning—Thermostat and element can be removed without disconnecting heater. To properly clean the "U" tube, heater should be disconnected from boiler.

Test

Connections and Method—Standard.
Temperature Head—10.5° C. to 9.5° C. after 24 hours.
Circulation—20.3 gals. per hr.
Losses—About 1.5%. There was an additional loss in the switch contacts of 11.5 watts, or about 1.2%.
Efficiency—98.4% exclusive of loss in switch contacts.
97.2% including loss in switch contacts, with water entering boiler at 70° C.
Watts Input—957 to 948 watts after 24 hours operation at 110 volts.
Maximum Surface Temperature—45° C. with 110 volts applied. This temperature was found on upper surface of heater, adjacent to element and was due to conduction through metal parts.
Insulation Resistance—3.6 megohms.
Galvanic E.M.F.—.42 volt between iron tube and copper sheath of heating element. Calculated current = .4 ampere.
Durability—Dry test not attempted.
Remarks—Production of this heater has been abandoned by the manufacturer but test is reported because the development is novel and interesting. The thermostat and switch have shown great reliability and long life in other apparatus when used with currents of not over 5 amperes. For ten amperes and above the carbon contacts have proven too light for continuous service. The insulation resistance of 3.6 megohms is too low for a mica insulated resistor and indicates a defective element. Much trouble was experienced with these heating units due to defect in manufacture.

Apfel Electric Water Heater

Date Tested—October 19, 1916.
Type—Immersion; Non-automatic—Serial No. 144.



Apfel Electric Water Heater

Volts—110.
Amperes—4.8.
Heat—Single.
Overall Dimensions—4 ft. 6 in. by 1 in. diameter.
Construction—The heater consists of a 17 in. spiral of resistance wire wound on an insulating spool and placed in the lower end of an oil filled ¾ in. galvanized iron pipe, 4 ft. 6 in. long. The heater is inserted from the top of the boiler with a threaded connection to screw into one of the standard top openings. When in place the heating element is about 14 in. from the bottom of the boiler.
Installation—Boiler must be disconnected and drained. Since heater occupies one of the top openings the cold water pipe must be connected to the bottom of the boiler.

Test

As an immersion heater must have a practically 100% efficiency, the test consisted in determining the temperature distribution in an insulated 30 gallon boiler equipped with this heater. The insulation consisted of 1 in. hair felt. No water was drawn off during test. Temperature measurements were obtained by mercury thermometers inserted into boiler at various elevations.

Test results are given on the accompanying curve sheet.

Durability—No test was made to determine the durability of this heater although information on this point is highly desirable.
Remarks—Results show that in the upper 60% of the boiler mixing is thorough and the temperature is quite uniform. In the lower 40 per cent the temperature falls rapidly so that the net effect is to reduce the available hot water storage by approximately 20%.

LOG OF TEST, THERM-ELECT HEATER

Cold Water Start

Date	Time	Hours of Run	Watts	Room Temp	T_1	T_2	T_3	T_4	T_5	T_6	T_7
8-23-16	11:00 a.m.	0	1400	18.3	20.3	20.3	20.3	20.2	20.0	20.0	20.2
8-23-16	11:30 a.m.	30	1400	19.4	25.0	24.4	24.4	25.0	24.5	24.5	23.0
8-23-16	12:30 p.m.	1-30	1400	20.0	33.0	33.0	33.1	33.5	32.0	33.2	32.0
8-23-16	1:30 p.m.	2-30	1400	20.0	41.0	40.9	40.5	41.0	39.9	40.1	38.0
8-23-16	2:30 p.m.	3-30	1400	20.0	50.0	50.0	49.9	50.0	49.9	49.8	51.0
8-23-16	3:30 p.m.	4-30	1400	20.2	59.0	59.0	58.0	59.5	59.9	59.9	59.8
8-23-16	4:30 p.m.	5-30	1400	20.8	65.0	63.5	63.5	65.0	63.0	63.5	60.2
8-24-16	8:00 a.m.	21-0	250	18.3	87.0	87.5	88.0	85.0	86.5	86.0	81.0
8-24-16	11:15		1000	20	84.1	81.9	79.8	81.5	78.9	78.	78.
5 Gallons Drawn Off											
8-24-16	1:30		1360	20.5	85	87	83	84.5	81	61	52
8-24-16	2:30		795	20.5	85	84	81	83	80	81	74.5
8-24-16	3:30		300	20	88	87.5	83	80.2	80.3	84	81
8-24-16	4:40		300	20.8	88.5	87.6	81	83	84.5	84.5	83
8-25-16	8:00		150	18.5	88	87.1	84.2	85.3	83	84.4	81
15 Gallons Drawn Off											
8-25-16	8:40		1375	18.7	86	84.9	81.1	77.2	45	39.1	34.4
8-25-16	9:30		1375	19	82	72	81.1	49.9	50.5	59.2	41.1
8-25-16	10:30		1375	19	80	78	75	68	67.5	66	62
8-25-16	12:00		1380	20	82	79.1	77	80	77	76.5	76
8-25-16	1:20		450	20	87.5	85.5	85	81.5	84.3	84.2	81
8-25-16	3:00		260	20	89	83	84.2	85.8	83	85	82.5
8-25-16	4:00		260	20	89	88.5	84	85.5	82.5	85	82
8-26-16	8:00		450	18.5	84	87	85	86	82.1	85	82
25 Gallons Drawn Off											
8-26-16	8:30		1390	18.5	82.5	79.8	59.5	42	35.1	33.5	30
8-26-16	9:30		1390	19	75	72	45	45	42.5	44	41.6
8-26-16	10:30		1395	19.1	70.5	66.5	54.5	55.1	52	54.8	52.1
8-26-16	11:30		1395	20.5	61.5	65	62.5	60.5	64	64	62.5
8-26-16	3:15		750	19.8	87.5	85.2	83	84	79	84	81

Thermometers are numbered from the top of the boiler.

Therm-Elect Water Heater

Date Tested—October 2, 1916.
Type—Immersion; Automatic. Serial No. 1061.
Volts—110.
Amps.—13.6.
Heat—Six.

Construction—The heater consists of an originally flat, metal sheathed element about 20 in. long, rolled into the form of a tube that is not entirely closed, to enable it to be inserted into a one-inch boiler opening. The heating unit is designed for insertion into the bottom of the boiler and is divided into six sections, of nominally 250 watts capacity each.

A thermostat is inserted into the side of the boiler in the opening usually provided in the standard 30 gallon domestic tank. It carries six switch contacts, each of which controls one section of the heating element. Portions of the heating unit are supposed to cut in or out in proportion to the temperature change and demand for current.

Provision is made for removing any accumulation of scale and sludge at the bottom of the boiler.

For further description, literature of the manufacturer should be consulted.

Test

The test consisted in determining the temperature distribution of water in an insulated thirty gallon boiler, equipped with a Therm-Electric heater and thermostat. Temperature runs were taken starting with boiler cold, and then after drawing off specified amounts of hot water. Record was also kept of the number of heater sections in circuit. Temperatures were obtained by mercury thermometers inserted into the boiler. The boiler insulation was one inch of hair felt.

Test results are given in accompaning curve and log sheet.

Remarks—From a study of test results the following conclusions are to be drawn:

Starting with a cold boiler, hot water is not accumulated in the top of the tank but all of the water in the tank must be heated before any is available at the desired temperature. Whether or not this is a practical objection will depend solely upon individual circumstances, chiefly upon the relation of storage capacity to daily needs.

When hot water is drawn off, any hot water left in the boiler remains in the top of the tank while the heating element warms the body of cold water below. During this time the temperature of the upper body of hot water gradually falls due to radiation and to heat conduction to the boiler shell and to the cold water below. When temperatures throughout the boiler have become approximately equalized, complete convection is resumed, and the entire body of water heated uniformly.

Due to the fact that the entire boiler contents are heated to approximately the same temperature, a maximum of heat storage is obtained for a given temperature setting of the thermostat.

Long life is claimed for the thermostat switch contacts and that the expansion and contraction of heater shell keep the element free from scale. Corroborative evidence, which could not be secured by laboratory test, is needed on both of these points. During this test the thermal switch contacts did not always open quickly or make good contact in closing, on which occasions appreciable arcing was observed. However, manufacturer states that operating records over several years show no trouble from this source and that none is to be expected, due to the nature of alloy used in the arcing tips and to the limitation of two hundred and fifty watts per contact.

Aqua Therm System

Preliminary Test

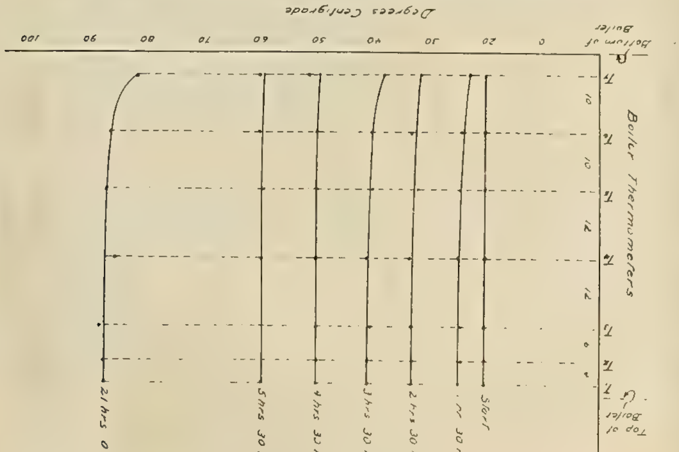
Date Tested—March 17, 1917.
Type—Type "H," Seriel No. 122. Immersion, automatic.
Volts—110.
Amperes—9.
Heat—Single.

Overall Dimensions—Will be included under a detailed description of apparatus.

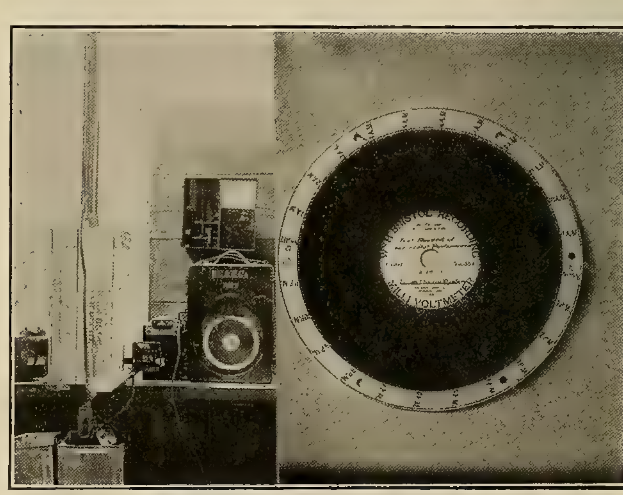
Weight—Including heating unit, thermostat and switch, 19 lb.

Construction—There are four principal parts, heating unit, thermostat, control switch and boiler insulation.

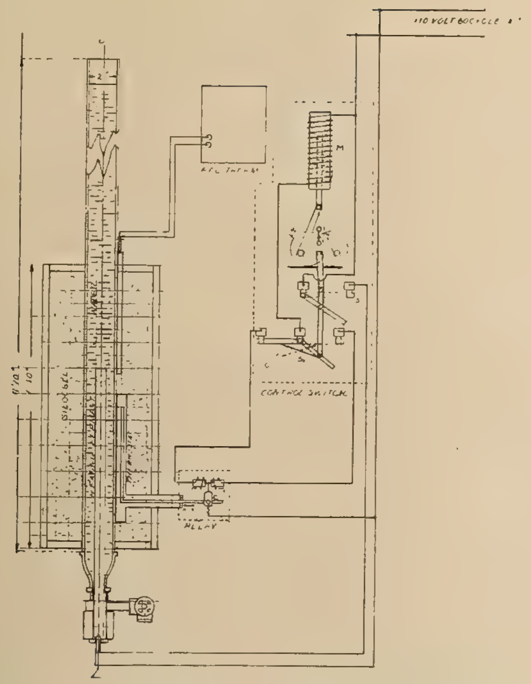
The heating unit is of the immersion type, intended for insertion into the bottom of a domestic boiler. It consists of a resistance wire enclosed in a flat copper tube 15 in.



The Therm-Elect Water Heater



The Aqua Therm Heater Under Test



Connections for Test of Aqua-Therm Model H System

long which is sealed at the upper end but provided at the lower end with a 1 in. pipe fitting that will also permit of water being drawn off in order to flush out accumulated dirt and scale.

The thermostat utilizes the expansion and contraction of a bimetallic strip to operate an electrical contact, thereby energizing an electromagnet which operates a switch controlling the heating unit. It is intended to be strapped to the surface of the boiler before heat insulating material is applied.

The control switch consists of a single pole, single throw knife switch and a single pole, double throw knife switch, connected to the same operating rod and to the plunger of a solenoid. The solenoid is energized by operation of the thermostat and, in operating, either closes or opens the heater circuit and, at the same time disconnects itself from the line so that it is in circuit only for a small fraction of a second at each operation.

The complete equipment and electrical circuits are shown on the accompanying diagram. Heating element, thermostat and relay and control switch are so labeled. M is the operating solenoid, S_1 the single throw switch controlling heater circuit and S_2 the double throw switch that disconnects the solenoid M.

Operation is as follows: With cold water in the boiler the relay contact "C" moves to the **left** and energizes solenoid "M" through the left-hand blade of S_2. The plunger is connected to a weight "W" pivoted eccentrically at O, and which, due to the force of the upward pull, is thrown from the solid to dotted line position. To this weight "W" is fastened the operating switch rod, which is lifted by the rotation of weight "W," and in its travel closes "S_1", and throws over S_2. During the first period of this operation the force is due to magnetic pull from the solenoid "M," which however, is interrupted by opening of switch S_2. During the latter part of the travel of the switch blade the necessary operating force is impaired by the fall of the weight W. In this manner, quick and positive action and full travel of moving parts are secured through energy imparted to the weight W, although the operating solenoid is part of this time out of circuit. When the desired water temperature is reached the thermostat relay contact "C" moves to the right and again energizes the solenoid "M" through the right hand blade of S_2, throwing "W" back to its former position, disconnecting heating unit and solenoid.

The solenoid and switches are mounted in an iron box 12 in. by 6 in. by 4 in. with hinged cover.

The relay contact piece "C" is of sheet iron and is held in secure electrical contact by means of the small magnet M_1 or M_2, which it energizes with each operation. Contact is made at C but interrupted at S_2. The travel of relay contact C is about .02 inch for forty degrees Fahrenheit range. Control of the temperatures at which the thermostat will cut in or out is secured by adjustment of the contact pieces, M_1 or M_2 which are readily accessible. The thermostat relay is contained in an iron box 4 in. by 4 in. by 1½ in. with exposed and removable cover.

Insulation—The manufacturers provide, as part of this equipment a galvanized iron casing to enclose a standard thirty gallon boiler with an annular space of three inches which is to be filled with infusorial earth.

Test

Connections and Method—In place of a standard boiler a two-inch pipe was used in order to obtain more rapid heating and cooling, with many more operations of the automatic apparatus than could be secured in a given time if applied to a thirty gallon boiler. A graphic recording thermometer was applied as indicated in the diagram, to show the temperature cycles and limits at which the thermostat would operate. The test consisted in a twenty-four hour run to observe temperatures and the mechanical operation of automatic apparatus.

Efficiency—100% for an immersion heater.

Boiler Radiation Loss—No test has yet been made with this equipment but results should be about the same as for the three-inch sil-o-cil covering previously reported.

Temperature Range of Thermostat—For this test the thermostat was adjusted to cut in at 135° and out at 175° F. The graphical temperature record is shown on page 232.

Temperature Distribution in Boiler—This heating element is similar to that used by the Therm-Elect heater and the heat distribution throughout the boiler should be alike in the two cases, if equally well insulated.

Mechanical Operation—Operation of the solenoid, M, was not satisfactory below 110 volts and at 103 volts it would not operate at all. Below 103 volts it was possible for the weight "W" to stick on dead center, in which case it could not be automatically restored but must be shifted mechanically. In this position there was sparking at all contacts, C, S_1 and S_2.

With sufficient voltage applied the solenoid is in circuit less than 1/10 of a second.

The quick break of switches reduces sparking to a minimum and insures long life of contacts.

The operation of the automatic switch is accompanied by considerable noise, which may be very annoying.

Remarks—The permanence of calibration of the thermostat is open to question but was not determined in this test.

In the heating element, the watts dissipated per unit of radiating surface appear unduly high, judging from past experience.

Tests of Heat Insulating Materials

Dates Tested—August 19 and September 2, 1916.

Materials Tested—Single ply and three ply hair felt, fabricated by the H. W. Johns-Manville Company and known as "Economy Boiler Covering."

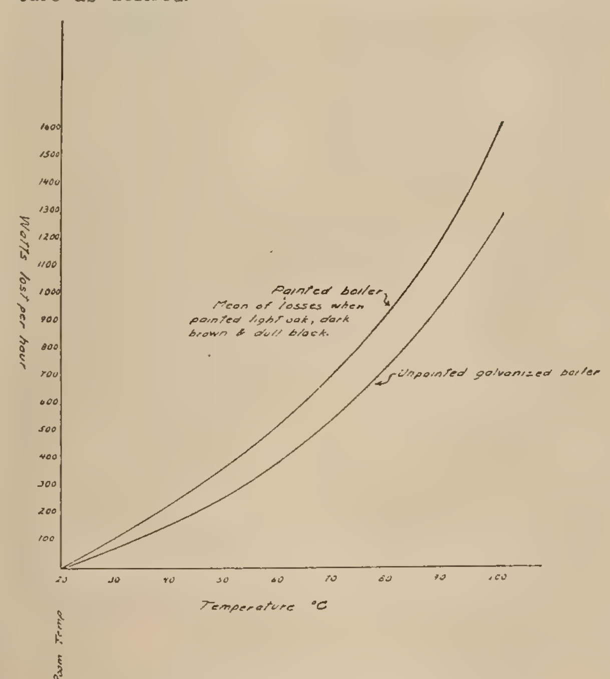
Powdered "Sil-o-cel" or infusorial earth, furnished by the "Kieselguhr Company of America."

Magnesia boiler covering.

Description of Materials—The "Economy Boiler Covering" consists of hair felt sewed up in canvas jackets, formed to fit a standard thirty gallon domestic boiler and held in position by lacing. The single ply covering consists of a single jacket, one inch thick. The three ply covering consists of three separate, concentric jackets, applied one over the other.

The magnesia was applied in the form of bricks to a total thickness of two inches, with an outer cloth covering.

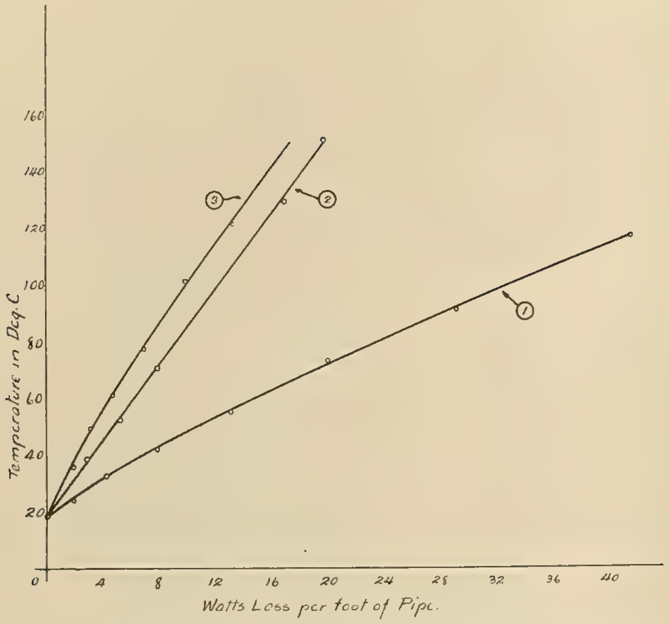
Method of Test—The purpose of test was to determine radiation losses from the boiler alone, disconnected from all piping. To that end the boiler was isolated and filled with water, which was heated to approximately the boiling point and the time-temperarue curve in cooling was determined. From the cooling curve and known quantity of water the radiation loss in B.t.u. or kilowatts can be readily calculated. Water temperature was determined by means of an immersed copper resistance thermometer extending from top to bottom of boiler, which gave the average temperature as desired.



Test of Losses of Bare and Painted Boiler

Test Results—Are given on the accompanying curve sheets.

Remarks—The heat loss from even a well insulated boiler is so large that, where, hot water is to be stored for any length of time and electricity for heating is sold on an energy basis, the best insulation obtainable should be used.



Test of Various Types of Pipe Covering

(Curve 1 is for ¾ in. bare galvanized iron pipe, curve 2 for the same pipe as curve 1, but insulated with "Economy" laced pipe jacket, and curve 3 is the same as curve 1 but insulated with 85% magnesia.)

Heat Loss from Uninsulated Boiler

Date Tested—August 21, 1916.

Purpose of Test—To determine the effect of the condition of boiler surface upon losses due to radiation and conduction from an uninsulated tank, at temperatures below 100 deg. Centigrade.

Method of Test—The same method was employed as that described under "Tests of Heat Insulating Materials." Four surface conditions were investigated, as follows:

Losses from boiler with bright galvanized surface.
Losses from boiler when painted light oak.
Losses from boiler when painted dark brown. (Second coat).
Losses from boiler when painted dull black. (Third coat).

The boiler under test was placed on a wooden stand in the middle of a room where the air could circulate freely about it.

Test Results—Are given in the accompanying curve sheet.

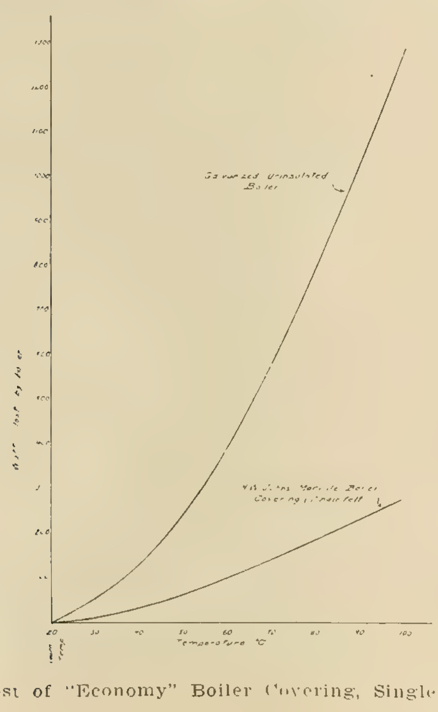
Remarks—The magnitude of the loss from an uninsulated boiler is so great as to compel the use of heat insulation wherever hot water is to be stored for even short periods of time and electricity used for heating is sold on an energy basis.

Adequate heat insulation will probably also pay where a cheaper fuel is used to heat water.

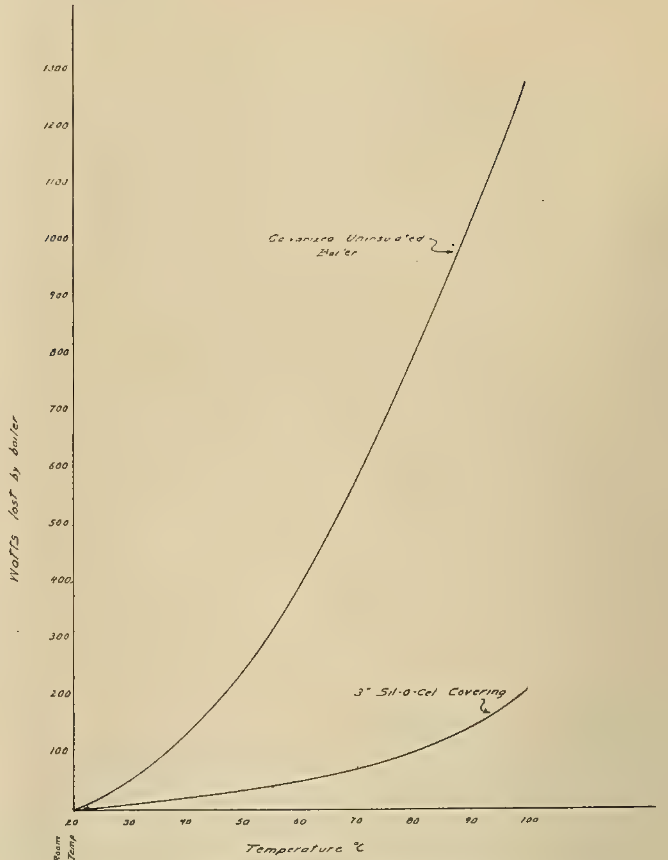
Heat Loss from Water Piping

Date Tested—August 23, 1916.

Pipe Tested—¾ in. galvanized water pipe as follows:
Bare.



Test of "Economy" Boiler Covering, Single Ply

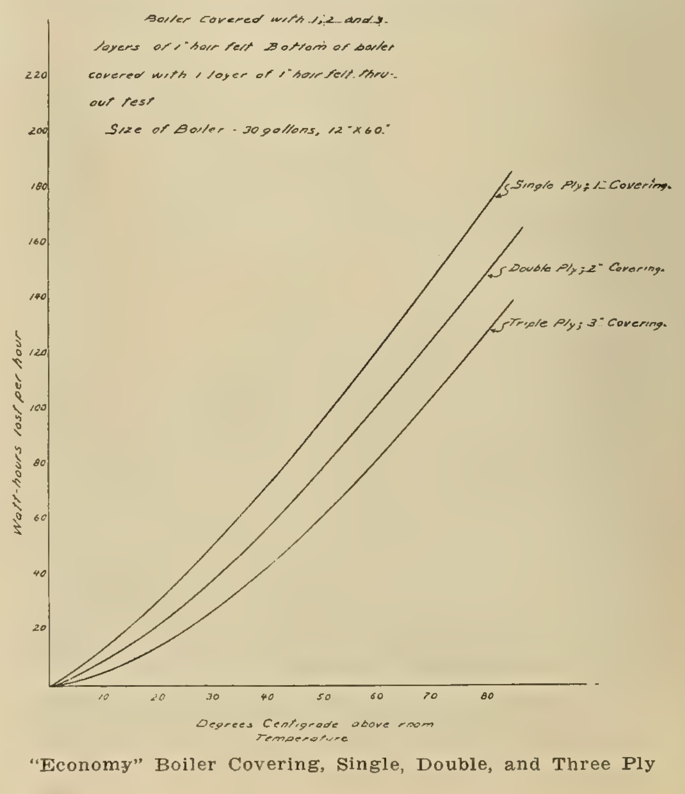


"Sil-o-cel" Boiler Covering

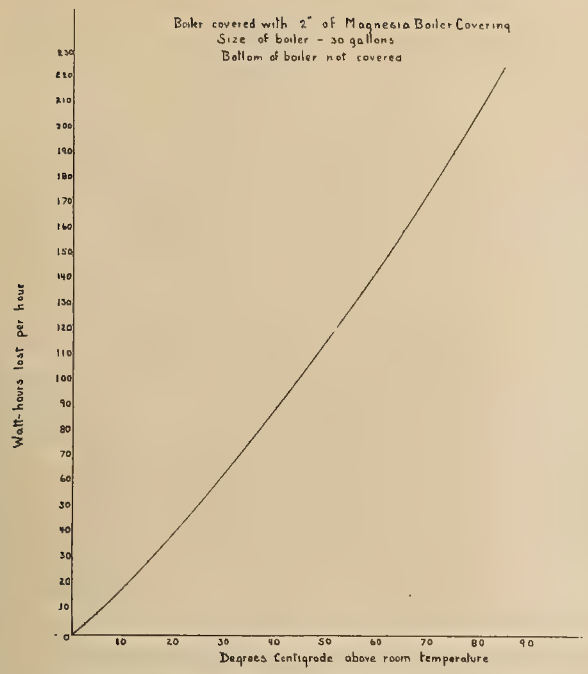
Insulated with ¼ in. hair felt sewed up in a laced canvas jacket. Marketed by the H. W. Johns-Manville Company as "Economy Laced Pipe Jacket."
Insulated with 1 inch of 85% magnesia.

Method of Test—Temperature of the pipe was determined from its electrical resistance, after first calibrating at 21.5° C. and 100° C. by passing through it cold water and steam respectively. Heat losses were supplied electrically by direct current, the same measurements determining energy loss and resistance.

A preliminary test was made to discover any difference in losses with pipe horizontal or vertical, but none could be detected. All observations were therefore taken on a 10 ft. length mounted horizontally in free air.



"Economy" Boiler Covering, Single, Double, and Three Ply



Test of National Magnesia Boiler Covering

Potential wires were placed 18 inches from each end.

The insulation available left six inches of bare pipe at each end. In order that none of the loss from the uncovered ends might be supplied by conduction from the section under test, these ends were kept as nearly as possible at the temperature of this section.

Test Results—Are given in accompanying curve sheet.

Remarks—Piping losses are of principal importance in connection with the circulation pipe, if one is used, which connects heater and boiler, and of possibly less importance in c nnection with the hot water service pipes because of the short periods for which they are in use.

If we assume the curves of these tests to be straight lines between the limits of 40 deg. C. and 80 deg. C., which covers the range of domestic hot water service, then the radiation losses per foot of pipe per degree Centigrade temperature difference above the surrounding air are as follows:

¾ in. Bare pipe	.30 watts per ft. per deg. C.
¾ in. Pipe, "Economy" covering,	.15 watts per ft. per deg. C.
¾ in Pipe, magnesia covering,	.11 watts per ft. per deg. C.

A 30 gallon boiler can easily be insulated so that the loss at 60 deg. C. with 20 deg. C. room temperature is about 75 watts. The circulation pipe, if a circulation heater is used, with allowance for elbows, tees and the increased area of fittings, will have a length equivalent to about eight feet of straight pipe. Under these conditions the losses would be about as follows:

Kind of Pipe Covering	Loss in Pipe	Loss in Boiler	Ratio of Pipe Loss to Boiler Loss
Bare pipe	96 watts	75 watts	128%
Economy	48 watts	75 watts	64%
Magnesia	35.2 watts	75 watts	47%

To this loss in the circulation pipe must be added the heater loss.

From these figures it is reasonable to conclude that the circulation pipe and heater should be insulated with as much care as the boiler itself. Furthermore, even with the best insulation obtainable, where hot water is to be stored for any length of time, the total losses with an immersion heater are probably from twenty to thirty per cent less than with a circulation heater.

ELECTRICAL UTILIZATION SAFETY ORDERS IN CALIFORNIA

BY JAMES M. BARRY

The recently enacted Electrical Utilization Safety Orders have caused many departures in the methods of making electrical installations. With a view to clearing up certain difficulties which have arisen, the following brief discussion by the department of electricity of San Francisco is submitted:

Location of Main Service Switches

Order 735 (a) states that main service switches "shall be placed in the nearest readily accessible place at the point where the wires enter the building and arranged to cut off the entire current." This requirement conflicts with the provisions of Section "J," Ordinance 2582.

Since the state law takes precedence over the city ordinances wherever the latter are in conflict with the former, Order 735 (a) only must be given consideration in the location of main service switches.

Complying with Order 735 (a), main service switch will usually be located as indicated for each of the following classes of buildings:

Office Buildings.—On main bulkhead in basement as near stairway as possible.

Apartment Houses With Basements.—On main bulkhead in basement as near stairway as possible.

Apartment Houses Without Basements.—Immediately within the door of tradesmen's entrance.

Garages.—As near the main entrance as practicable.

Flats and Dwellings.—Immediately within the door of tradesmen's entrance. If service comes in from the rear, as is the case in many residence parks, main service switch shall be located in rear of the building.

The foregoing is intended as a guide only. The department reserves the right to exercise its discretion in interpreting Order 735 (a). In submitting the above suggestions, it is not the intent of the department to deviate from the provisions of Order 735 (a).

Kind of Switches to Use

(1) All switches, regardless of voltage, must be of the bottom fused type, with the service coming in at the top, so that blades and fuses will be dead when switch is open.

(2) Switches to be used in two-wire and three-wire a.c. single-phase services of less than 150 volts to ground need not be of the externally operated type unless they are located in permanently damp places or where local conditions entail a particular hazard.

(3) All service switches, except those noted under (2) shall be of the externally operated type. Externally operated switches shall fulfill these conditions.

(a) The cover of the cabinet containing the switch shall be so interlocked with the switch mechanism that the cover cannot be opened until the switch is opened.

(b) The cover shall be so interlocked with the switch mechanism that the switch cannot be closed while the cover is open.

Disconnection of Fusible Cutouts Before Handling

All main circuits and branch circuits, except branch lighting circuits, shall be provided with switches to disconnect the circuit fuses before handling.

This means that a separate switch will be required for every circuit, except **branch lighting circuits** emanating from panel boards or centers of distribution in a building.

Where one lighting circuit supplies the entire current to a consumer, as, for example, in some apartments, such a circuit **will not** be considered a branch lighting circuit; in every such case, a switch will be required ahead of the cutout.

Where several switches are grouped at a center of distribution, these switches need not be of the externally operated type, if they are not operating switches. In the ordinary case, these switches will be used merely for disconnecting the cutouts when it is necessary to re-fuse a circuit. The cabinet containing the fused switches shall have marked on the cover a warning against the removal of fuses until the switch controlling same is opened.

Where switches at centers of distribution are used to actually control apparatus such as motors, furnaces, etc., these switches must be of the externally operated type.

STANDARD CONDUIT INSTALLATION

BY L. A. BARLEY

(Conduit construction offers a broad field for discussion as to its advantages, disadvantages, comparative cost, installation rules, and a host of other questions that arise in the art. The rules of the Fire Underwriters for conduit construction are important in protection to property and in security to life. Herein are discussed salient features of conduit construction of much interest to central station managers and men of the electrical industry by an author who is with the Rocky Mountain Fire Underwriters, with headquarters at Denver. This paper was delivered before the recent convention of the New Mexico Electrical Association.—The Editor.)

The subject assigned me for discussion at this, the third annual meeting of the New Mexico Electrical Association, I believe to be of general interest to all central station men as well as to electrical contractors and wiremen. The advantages, disadvantages, comparative cost, installation rules, etc., of metal conduit construction offer a broad field for discussion. However, I will only attempt to touch upon some of the more important features which I believe should be of especial interest to the members of this Association.

The use of metal conduit in this state, until within the last two or three years, has been comparatively limited and the inside wiring in general has too often been installed in the cheapest manner possible. This, I feel, was due largely to the inferior type of early building construction which would not warrant permanent or expensive electric wiring systems; also the property owners in many instances did not seem to realize the importance of having the wiring installed in accordance with the national rules and the best engineering practices for the safe-guarding of the fire hazard and securing effective and economical distribution of electric current. I am pleased to observe, however, that within the last year or two there has been a very noticeable improvement in the class of building construction throughout the state, carrying with it a better class of electric wiring installation.

With buildings of reinforced concrete or protected steel construction it is necessary, owing to the nature of such construction, to employ the conduit type of wiring. Many of the more progressive architects and builders are now insisting on conduit in the better class of buildings of ordinary brick or stone construction.

It is generally conceded that metal conduit construction, properly installed, constitutes the safest and must permanent method of electric installation. The various electrical associations, fire prevention bureaus, and fire underwriters, in formulating the rules and requirements of the National Electrical Code, have recognized this fact and have made conduit construction a mandatory requirement in certain risks of an especially hazardous nature, such as automobile garages, theaters and motion picture houses. It is likely that this requirement will be extended within the next year or two to apply also to all public buildings, schools and churches.

The average merchant or business man is, I find, often under the impression that any metal conduit installation absolutely eliminates any possible chance of an electric fire. If the system is installed in a proper manner in accordance with the rules governing this class of construction, the chances for any trouble on the system has been reduced to the minimum without doubt. We often find, however, the conduit installed in a very crude and unskilled manner and, if in a building of ordinary construction, it constitutes, in my opinion, a more serious hazard than would be possible with the ordinary knob and tube method. The installing of metal conduit is really a trade in itself and, while a wireman may be skilled and thoroughly competent to install a standard knob and tube job, he will seldom be qualified to install a satisfactory conduit system without some experience and training in this particular class of electrical construction. I will mention some of the more common defects found in this class of wiring.

One of the most important features frequently neglected is the grounding and bonding of the conduit system. The code rules specify that metal conduits containing service wires must be insulated from the conduit system and all metal work in the building (which is seldom practical), or be permanently and effectually grounded to water piping or other suitable grounds. Connections to ground pipes and to the conduit system must be exposed to view or accessible, and must be made by means of approved ground clamps. Where the largest wire contained in the conduit is not greater than No. 0, the ground wire must be of copper at least No. 6 B. & S. gage, and No. 4 where the largest wire in the conduit is greater than No. 0.

If the entire conduit installation is one continuous system or has the separate sections thoroughly bonded together, the ground on the service conduit will be sufficient for the entire system. In mixed knob and tube and conduit work it will be necessary to bond the separate sections of conduit together or ground each portion separately. While the code rules do not make any provision for omitting the grounds on short lengths of conduit, it is the general practice to not provide grounds for conduit runs of say 8 or 10 ft. in length. In selecting a proper grounding pipe it is best to connect to some permanent piping not less than three-fourths of an inch in size where available; otherwise, the ground connection is liable to be disturbed and may be entirely removed by the plumbers or other workmen in replacing or moving piping of a less permanent nature. Especial care must be taken to see that all rust or enamel is removed from pipes at connections and the bonding clamps must be tightly secured in place to maintain an effective electrical contact. If the ground wire is subject to mechanical injury, it must be protected in a substantial manner by piping or moulding. In buildings where no grounding pipes are available it is often necessary to drive a pipe into the ground either on

the inside or outside of a building at a point near the service entrance. If located on the outside of building, care should be taken to have the pipe securely fastened to building or pole and guarded from injury from wagons and other vehicles. The ground pipe should extend at least 7 ft. above the ground in such cases.

The location and arrangement of the service cabinet and service devices is another feature of material importance. The code rules state that "an automatic cutout shall be placed on all service wires in the nearest assessible place to the point where they enter the building and inside the walls." With the ordinary low potential light and power installations, the automatic cutout consists of a two or three pole fuse block. The service switch must also be located at this point but is now permitted placed on either side of the cutout. Both of these devices must be arranged to cut off the entire current from all devices, including meters.

Owing to the fact that the service wires, up to the point where the service cutout is located are without fuse protection except that afforded at the transformer (which in most cases would far exceed the safe carrying capacity of the wires), it is very essential to have these devices located as near as possible to the point of service entrance, thereby reducing to the minimum the length of unprotected conductors within the building. The service switch, to be readily accessible (as required), must be located not over 7 ft. above the floor. To secure a readily convenient location for the switch and have the two devices installed in the same cabinet, it is sometimes advisable to make some sacrifice in nearness of the cabinet to service entrance, but the distance from point of entrance to service cabinet must in no case exceed 15 ft.

The service conduit must be equipped at outer end with approved condulet or pot-head fittings of the waterproof type and must be continuous (without junction or pull boxes) into cabinet. The cabinets must be of sufficient size to contain the devices without crowding and with required space between exposed current carrying parts and walls of cabinets. All cabinets must be constructed in accordance with the standard requirements and bear the Underwriters Laboratories' label of approval. Cabinets, when used for the enclosure of apparatus connected within the cabinet to the wires of more than four circuits, not including the supply circuit or a continuation thereof, shall have a back wiring space or one or more side wiring gutters, or side wiring compartments, unless the wires leave the enclosure directly opposite their terminal connections.

Meter loop outlets must be equipped with approved type outlet boxes or condulet fittings with separate porcelain bushed holes for each wire, or with cover constructed entirely of porcelain with separate holes for each wire. When meter is located directly adjacent to cabinet, the meter loops may be brought out of the enclosure through separate, porcelain bushed holes. Junction, outlet boxes, etc., must always be installed in such a manner as to be readily accessible. We quite frequently find this rule violated in mixed construction, the junction box being concealed between ceiling and floor in places where it is necessary to run down a brick wall in conduit for switch loop. The proper method would be to locate the junction box in the ceiling, flush with the plastering and equipped with blank cover. Where this would be objectionable on account of the appearance, the conduit could be extended to the nearest light outlet in the ceiling and the box located at this point. The canopy of the fixture would thereby conceal the box from view. Conduit should be securely supported and installed in a neat workmanlike manner, free from sharp bends that would tend to flatten or injure the conduit; also should enter cabinets, junction boxes, etc., at right angles and not in a diagonal manner.

The wireman should be provided with all necessary fittings, pipe bending tools, etc., if he is expected to install conduit in a satisfactory manner and without waste of time. In all classes of wiring, we find that a neat job usually proves to be a good job. The electrical contractor or wireman should always remember the old saying, "What is worth doing at all is worth doing well."

WEIGHTS AND MEASURES BY BUREAU OF STANDARDS

A new publication of the Bureau of Standards entitled "Eleventh Annual Conference Report, Weights and Measures, 1916," has just made its appearance. This report is a record of the proceedings of the conference, which is a body composed of state and local weight and measure officials from all parts of the United States. Some of the principal matters contained therein are short reports on legislation and general conditions existing in the United States; suggestions, discussions, and resolutions as to the proper method of sale of coke, of fruits, vegetables, etc., and of wrapped meats; technical papers on the selection and maintenance of apparatus in industrial plants, on the inspection, test, installation and maintenance of railroad track scales, and on liquid-measuring pumps; reports and discussions in relation to the adoption and use of the metric system of weights and measures, and of the Centigrade scale of temperature; and discussions by manufacturers of weights and measures and weighing and measuring devices of tolerances and specifications, of new types of scales, and other matters of interest. The tolerances and specifications for weights and measures and weighing and measuring devices heretofore adopted, were broadened by the addition of several new classes of apparatus, and the complete tolerances and specifications are included as an appendix to this publication.

REPORT ON PETROLEUM FOR 1915 ISSUED

A publication of considerable general interest now available for free distribution by the United States Geological Survey, Department of the Interior, is the annual statement on petroleum in 1915. This report on development in the oil fields of the United States during the year includes brief notes on the trend of developments in foreign oil fields so far as conditions can be ascertained.

AMERICAN OPPORTUNITIES IN CHINA

BY JULEAN ARNOLD

(Engineering and commercial bodies up and down the Pacific Coast are giving much study to American opportunities in countries bordering the Pacific. Here is an eloquent appeal by the American commercial attache to China, who has given fifteen years of study to the question of American opportunities in that country. The matter contained in this article has been prepared for the columns of the Journal by the author from a recent paper presented by him before the Oregon Society of Engineers and from a paper to be presented before the San Francisco Electrical Development and Jovian League on April 4, 1917. The illustrations are taken from a collection made by the editor of the Journal while on a recent tour of the Orient in the interests of gathering data for forecasting the engineering outlook in that section of the world in its relation to the Pacific Coast.—The Editor.)

Moonlight on the Yangtze, a Navigable River Serving More People Than Any Other Inland Water Source in the World

WE read much in our newspapers and trade journals about the opportunities for trade in South America and much is being done to avail ourselves of these opportunities. While we should do everything possible to encourage our trade in South America, yet in so doing we should not overlook a field of far vaster opportunities than South America can offer. Few of our people seem to appreciate the fact that China has a population ten times as great as the aggregate population of the whole of South America. Few people seem to realize that although Chinese civilization extends back 5,000 years, China is today one of the richest countries in undeveloped natural resources on the face of the globe. China possesses a store of wealth in iron, coal, lead, copper, zinc, tin, antimony and other base metals as great or greater than that of the United States.

Although China has what will probably prove to be as rich and as extensive deposits of coal as has the United States, yet China today imports coal. Where coal and iron abound in large quantities, especially when combined with a dense population of peace-loving industrious inhabitants, there modern civilization will take its path. China also has a vast wealth in undeveloped water power. Up to the present industry in China has been of the household variety. No incentive has been given to the people by the State in invention. Stop and think what our patent laws have meant to our industrial development. Can you conceive of this development without federal protection and encouragement to invention? China has been without this. The steamboat, the locomotive, the telegraph, the sewing machine, the telephone, the gasoline engine, the aeroplane have called great industries into existence as have also many other of our inventions. Through modern inventions 5,000,000 are today doing in our factories with the aid of patent-covered inventions what would be impossible with the labors of twenty times this number.

Although China is an agricultural nation, about 80 per cent of its people being engaged in agriculture, yet she has not the advantages of one of the 50,000 patents issued in the United States to cover agricultural implements and machinery. Although China embraces an area as large as the United States, Mexico and Central America combined, yet vast areas of the richest sections of its country are cut off from the markets of the world and from commercial intercourse with the rest of the nation, because of the lack of railways. China has today 6000 miles of railways and will require upwards of 100,000 miles to handle her transportation needs. In sections devoid of waterways and yet unconnected by rail, native methods of transportation, even with labor selling at ten cents a day, are from ten to twenty times as expensive as rail trans-

The Engineering Feat of All History, the Great Wall of China, Sixteen Hundred Miles in Length

The Shipping District of Canton, the Commercial Mecca of Southern China

portation in the United States, with wages twenty times as high.

Think of what our electrical developments have meant to our progress and then see China with four times the population and with a wealth of water power yet with no generating plants for electricity. The efficacy of modern education, of western learning is now recognized by China and her educational system since 1905 has taken cognizance of her past shortcoming in this direction. China is today at the threshold of a grand industrial development. She now wants railways, factories, electrical power plants, and is preparing to open her vast stores of mineral resources. No stretch of the imagination can conceive of the stupendous extent of the developments which will take place in China during the next few decades. The commercial opporunities which will follow in the wake of these developments will result in shifting the world's commercial arena from the Atlantic to the Pacific. Is America preparing for these marvelous opportunities? What country should be able to profit by them to a greater degree than should the United States? What country is better capable of handling the big things in mining, railroading, engineering, and industry than the United States? What people are in a position better to finance these big activities than are the people of the United States?

Fortunately for us China welcomes American participation in the creation of the new China, in fact China prefers American to all other assistance, for she has learned through experience with the nations of the West, that America does not stand for the exploitation of China for selfish aims, that America respects her territorial integrity, that America has China's welfare at heart. Thus China begs for American assistance and American participation in the rebuilding of her country, in the opening of her vast treasure houses of natural wealth, and in establishment of a sound political and economic system. Americans have been too prone to entrust their interests and opportunities in China to those of other nationalities.

Can we not do the work in China for ourselves and as well, if not better than others? The only way to meet the great big opportunity staring us in the face over there, is to do it through our own organizations. We must go over them and take our capital, material and technical skill with us. That is what China asks and wants us to do. No other country on the face of the earth offers opportunities of such magnitude and no other people on the face of the earth are so kindly disposed and so friendly toward us as are Chinese. Do not let us be frightened off by reports of revolutions and rebellions. China is no second Mexico. During her revolutions and rebellions no foreign lives were endangered. All foreign property losses suffered during these trying times were indemnified in full by the Chinese government. Moreover China has always met her foreign obligations fully and promptly. What better record can we ask? Our biggest opportunity lies across the Pacific. We are asleep to this fact.

We should be making a serious study of this our most important question. We should do everything in our power to bring China to the United States, so that our people may know that country and its people better, for in knowing them better, they cannot but be impressed by the marvelous opportunities which that country has in store for us. We must get the habit of thinking China.

SIZE OF FRESH WATER LAKES OF THE UNITED STATES

(Considerable discussion has of late prevailed in certain districts of the West as to the relative size of fresh water lakes in the United States, without taking the Great Lakes into consideration. A recent letter from the Acting Director of the United States Geological Survey will entirely clarify the situation as set forth in the letter that follows.—The Editor.)

Sir:

The following list comprises what are believed to be the 15 largest fresh-water lakes in the United States:

Lake of the Woods, Minnesota and Canada, 1500 square miles, Encyclopedia Britannica.

Tulare Lake, California, varies from 0 to 800 square miles. U. S. Geological Survey Water-Supply Paper 299.

Okechibee, Florida, 730 square miles. Report of Florida Everglades Engineering Commission; Senate Document 379, Sixty-third Congress, second session.

Pontchartrain, Louisiana, 625 square miles. Planimeter measurement on General Land Office map.

Salton Sea, California. (Dec. 31, 1908), 443 square miles; shrinking. U. S. Geological Survey Water-Supply Paper 290.

Red Lake, Minn. (both lakes), 441 square miles. Report of State Drainage Commission of Miinnesota, 1911-1912.

Lake Champlain, New York and Vermont, 436 square miles. U. S. Geological Survey Water-Supply Paper 284.

Lake St. Clair, Michigan and Ontario, 410 square miles. Lakes of North America, by I. C. Russell.

Rainy Lake, Minnesota and Canada, 310 square miles. Report of State Drainage Commission of Minnesota, 1911-1912.

Leech Lake, Minn., high water, 234 square miles; low water, 173 square miles. Report of State Drainage Commission of Minnesota, 1911-1912.

Mille Lacs, Minn., 207 square miles. Report of State Drainage Commission of Minnesota, 1909-1910.

Winebago Lake, Wis., 215 square miles. Wisconsin Geological and Natural History Survey Bulletin 36.

Lake Tahoe, Cal., 193 square miles. U. S. Geological Survey Water-Supply Paper 290.

Flathead Lake, Montana, 188 square miles. Planimeter measurement on U. S. Geological Survey base map (scale 1:500,000) of Montana.

Utah Lake, Utah, 145 square miles. U. S. Geological Survey Water-Supply Paper 290.

PHILIP S. SMITH, Acting Director.

WITCHING FOR WATER WITH WILLOW SWITCH

(Perhaps no discussion in the West has been more broadcast among informal gatherings than that relating to the so-called "water witch" and his power to locate underground sources of water supply by means of the willow twig. Witching for water is evidently not a new accomplishment if ever it may have been said to have arrived at the stage of being called an accomplishment, for the following article, prepared by the Director of the United States Geological Survey, shows that it is founded upon an ancient superstition disseminated broadcast throughout the civilized world.—The Editor.)

The idea that a forked twig, or so-called divining rod, is useful in locating minerals, finding hidden treasure, or detecting criminals is a curious superstition that has been a subject of discussion since the middle of the sixteenth century, and still has a strong hold on the popular mind, even in this country. This is evident from the large number of inquiries received each year by the United States Geological Survey, Department of the Interior, as to the efficacy of such a twig, especially for locating underground water. To furnish a reply to these inquiries the Geological Survey has published a brief paper, by Arthur J. Ellis, on the history of water witching, with a bibliography that includes a truly astonishing number of books and pamphlets on this uncanny subject.

In summary the paper states: It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited. It is by no means true that all persons using a forked twig or some other device for locating water or other minerals are intentional deceivers. Some of them are doubtless men of good character and benevolent intentions. However, as anything that can be deeply veiled in mystery affords a good opportunity for swindlers, there can be no reasonable doubt that many of the large group of professional finders of water, oil, or other minerals who take pay for their "services" or for the sale of their "instruments" are deliberately defrauding the people and that the total amount of money they obtain is large. To all inquirers the United States Geological Survey therefore gives the advice not to expend any money for the services of any "water witch" or for the use or purchase of any machine or instrument devised for locating underground water or other minerals.

History of the Superstition.—In tracing the history of the subject it is found that divining rods have been used (1) to locate ore deposits, (2) to discover buried or hidden treasure, (3) to find lost landmarks and re-establish property boundaries, (4) to detect criminals, (5) to analyze personal character, (6) to cure diseases, (7) to trace lost or strayed domestic animals, (8) to insure immunity against ill fortune by use as a fetish, (9) to locate well sites, (10) to trace the courses of underground streams, (11) to determine the amount of water available by drilling at a given spot, (12) to determine the depth at which water or ores occur, (13) to determine the direction of cardinal points, (14) to determine the heights of trees, and (15) to analyze ores and water.

The origin of the superstition is lost in antiquity. What is believed to be the first published description of the divining rod is contained in Georgius Agricola's "De re metallica," which was published in 1556. The device became common first in Germany as a means for locating mines and also for discovering buried treasure, a matter of rather common interest in those days, when the practice of burying money and plate for safe keeping was very general. It was introduced into England by German miners during the reign of Elizabeth (1558-1603), and before the end of the seventeenth century it had spread through the countries of Europe. Everywhere it aroused controversy. The rules prescribed for the cutting of the twig partook largely of heathen sorcery and astrology. There were indeed, to some extent, unconscious reminiscenses of the old Scandinavian and even of the Aryan mythology. But this heathen influence was offset when the rod was duly Christianized by baptism, being laid for this purpose in the bed with a newly baptized child, by whose Christian name it was afterward addressed. It is readily conceivable that the motive for surrounding this practice with a religious atmosphere might not have been altogether a belief in its divine character, for at that time any one found engaged in mysterious works was in danger of being charged with sorcery and burned to death.

Recent Discussions.—In the later part of the eighteenth century an attempt was made to explain water witching as an electric phenomenon, and later it was discussed as a psychic phenomenon. At almost every step in the advance of science some one has attempted to explain its supposed operation by means of the latest scientific theories.

Before the present war there were several societies in Germany whose sole object was said to be the study of the divining rod. In 1910 the department of agriculture of France appointed a committee to investigate the subject, and in 1914 this committee was still investigating.

A copy of the Government report, which is published as Water-Supply Paper 416, can be obtained by addressing the Director, United States Geological Survey, Washington, D. C.

A unique service has been inaugurated by the Southern Pacific Company to provide a simple inexpensive lunch service for coach passengers who may not desire a meal in the dining car. A neatly equipped "wagonette," loaded with tempting but simple edibles consisting of sandwiches, lunch boxes, fruit, pies, cold meats, hot coffee and chocolate in thermo bottles with necessary cups, saucers, knives and forks, is wheeled through the car by the traditional black-faced gentlemen, spotless in white garments and head gear.

COST OF BROODING BY ELECTRICITY

BY E. A. WILCOX

(In the issue of the Journal for February 1, 1917, an article was published on "Incubating and Brooding by Electricity," which has created so much interest among readers of the Journal that we publish herewith a second installment on costs involved in this recent application of electrical energy to the great chicken-raising industry of the West. The author, who was formerly electric heating specialist for the Great Western Power Company has recently compiled a most useful book on Electric Heating published by the Technical Publishing Company of San Francisco from which this article is taken.—The Editor.)

Brooding of Chickens.—The chick which is taken from the incubator to the brooder at the age of twenty-four hours (and known as a "day old chick") is not fed for another similar period or until the chick is about forty-eight hours old. The reason for this, is that the chick has absorbed the yolk of the egg into its digestive organs just prior to pipping, and continues to live on this food for the entire forty-eight hours. The chick's first meal should consist of grit, such as coarse sand, after which it may be fed some good chick food.

The temperature of the brooder should be kept at about 95° F. for the first week and gradually dropped for the next five weeks or until the chick is sufficiently matured to roost. It is important to watch the temperature carefully with very young chicks, because otherwise they will become restless and crowd together as soon as their backs get cold. If the crowding becomes too severe, the chicks will sweat and become weak and the less rugged ones may be smothered.

Rectangular Type Chick Brooder in Operation

A chick demands plenty of oxygen, (about 10 times as much as a person in proportion to its weight), and if it is to mature rapidly and develop good lungs, the brooding must be done in a well ventilated room. The chick should not be subjected to drafts of air, however, and best results are secured in a room having a tight floor and provided with high ventilation. The temperature of the room is immaterial as long as the proper degree of heat is maintained inside the brooder. Coarse straw or sand is usually spread out beneath the brooders.

Electric Brooders.—These devices are built in round, square, or oblong shapes, and in capacities of from 50 to 1200 chicks. The tops of the hovers are usually made of wood insulated beneath with asbestos, and supported on short wood or metal legs. Strips of canvas or oilcloth, wide enough to reach the floor and retain the heat, are fastened around the outer edges, and slitted perpendicularly every few inches to allow the chicks to pass in and out readily.

In the circular type hover, the heating element is placed in the center of the top, and in other types coiled wire heating elements are arranged around the top, in order to secure a wider distribution of heat. The air, when heated, banks against the insulated top and settles down upon the backs of the chickens. One or more holes are generally drilled in the floor beneath the machines to introduce a proper amount of fresh air inside.

The thermostat for regulating the temperature inside the hover is mounted a few inches below the top and adjusted by a screw on the outside.

Round Type Electro-Hatch Hover in Operation

A well constructed brooder is usually provided with about 100 watts capacity per hundred chicks. The current consumption has been found to average about 20 kw-hr. per hundred chicks.

Advantages of Electric Brooders.—Almost all the advantages that apply to electric incubators, apply as well to electric brooders. They save time, labor, and anxiety. They insure even heat distribution, easily controlled temperatures, and elimination of fire hazard. The electric heat neither burdens the atmosphere with poisonous fumes, nor destroys its oxygen. It has furthermore been demonstrated in actual practice, that an electrically brooded chicken is usually ready for

Electro-Hatch Rectangular Type Brooders in Operation

the roost about two weeks sooner than one brooded by fuel heat, and is universally stronger and more vigorous.

Statistics show that an average of less than 50 per cent of the baby chicks placed under the many types

Interior of Brooding House, Baywood Poultry Farm, San Mateo, Cal

of brooders now in use are raised to the roosts, whereas actual tests made during the past eighteen months with a large number of electric brooders show that the proportion has been raised by their use to better than 85 per cent.

Relative Costs of Operation.—The following will give an idea of the relative costs of fuel and electric operation of brooders. The data are averaged from many figures secured in actual practice, and are based on an assumed outside temperature of 50° F.

Relative Costs of Heat for Brooding

Method of Heating	Approximate Cost per 100 Chicks
Artificial 600 B.t.u. gas at $1.50 per 1000 cu. ft.	$1.50
Artificial 600 B.t.u. gas at $1.00 per 1000 cu. ft.	1.00
Coal oil at 20c per gallon	1.40
Distillate at 8c per gallon	.45
Distillate at 8c per gallon (blue flame burner)	.15
Electricity at 5c per kw.-hr	1.00
Electricity at 3c per kw.-hr	.60
Electricity at 2c per kw.-hr	.40

It is apparent that, although electric energy may have to be purchased at a low rate to compete with fuel on the basis of actual cost of heat energy, the advantages accruing to the user of electrically heated apparatus will more than offset this added expense.

CONCLUSIONS ON CHEMICAL AND ELECTRICAL CONDUCTIVITY.

In a recent investigation by Colin G. Fink it was established that in general we may conclude that the electrical conductivity of a substance is primarily dependent upon the shape and the distribution of the fundamental grains or particles composing the substance, and secondly, upon the presence or absence of thin films of secondary material enveloping these ultimate grains.

SUGGESTED CHANGES AND EXTENSIONS OF U. S. WEATHER BUREAU SERVICE IN CALIFORNIA

The recent discussion in the American Society of Civil Engineers by Geo. S. Binckley and Chas. H. Lee has definitely culminated in the recommendation of the following changes and extensions of U. S. Weather Bureau Service in California:

1. That the law creating the United States Weather Bureau prescribes a wide range of duties, among which the gathering of precipitation records is but incidental.

2. That there is an urgent demand among engineers, throughout the United States, for more complete precipitation data throughout mountain drainage areas, to be used in conjunction with stream-flow data.

3. That the present fiscal regulations, organization, and administrative policy of the Weather Bureau are not adapted to the task of gathering complete precipitation data of the character desired by engineers.

4. That Congressional action should be sought, either to change the organization of the Weather Bureau, so that the desired result can be accomplished, or else that the duty of observing all factors affecting stream flow be turned over to the Water Resources Branch of the United States Geological Survey, with the appropriation of sufficient additional funds to carry on the work efficiently.

DECAY IN BUILDINGS

Much discussion during the year of interest to men of the electrical industry occurred in the technical lumber press over the decay of wood in buildings. Several cases of bad failure were reported. Research was started by the Forest Service to determine the "killing points" in temperature and humidity of common fungi found in American buildings. These studies have already yielded data of considerable importance. It was found, for example, that with a temperature approximately 100° F., and a high humidity, the mycelia of certain fungi can be killed.

Field and laboratory studies indicate that much more care should be exercised in the selection of timber and in the construction of buildings to avoid conditions favorable to decay. A number of inspections of buildings which have given trouble on account of decay have shown that any one of the following causes may result in rapid deterioration of the building.

1. The use of green timber.
2. Allowing timber to get wet during construction.
3. Allowing the timber to absorb moisture after the building is finished, because of leaks or lack of ventilation.
4. The use of timbers containing too much sapwood.
5. The use of timbers which have already started to decay.

The avoidance of these conditions will, as a rule, prevent decay. In special cases, however, decay can only be prevented by preservative treatment. For this purpose, salts such as zinc chloride and sodium fluoride are better than creosote for buildings.

MERCHANDISING ELECTRICAL ENERGY

(The reservoir is each day proving itself of high economic value in lessening the costs of electric pumping supply. In Southern California earth basins constructed in light or sandy soils are rendered water tight by applying a coat of cement or lime plaster around the inside of the basin or else by spraying on the bottom and sides of the reservoir eighty to ninety per cent asphaltum base oil. Here are cost data of great value, which cover this recent phase of auxiliary supply for electric irrigation pumping. The author is commercial agent for the Southern Sierras Power Company at Riverside, California.—The Editor.)

Completed Bank—Preparatory to Oiling

Interior Basin—Unoiled

THE RESERVOIR

BY ROSS B. MATEER

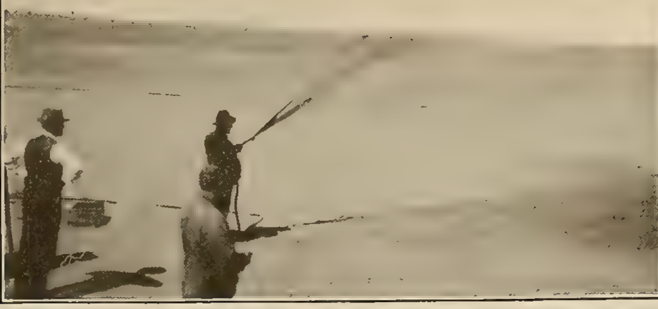
As a sequence to the plowing up, several years ago, of a large acreage planted to alfalfa a series of observations conducted by a southern public utility showed, somewhat to the astonishment of the rancher, that the apparently high cost of water pumped per ton of alfalfa grown was not the result of the charge assessed per kilowatt hour of service rendered, but directly due to the quantity of water pumped and the high lift. In certain districts the unpumped water level ranged from sixty to seventy-five feet and the total head varied, when operating the large unit, from one hundred to one hundred and ten feet. This situation has now been overcome by the installation of small pumping plants, operating seven hundred or more hours each month, and delivering to an earth or cement reservoir a quantity of water approximately equal to one-half an inch of water per acre under cultivation, with a decreased cost of operation and the satisfactory irrigation of the soil by daylight, and with such quantities of water as is desired to draw from the storage basin, and which can be carried advantageously in the pipe line. The basins constructed and in service the past two years were of three general types; (1) those with embankments of the soil native to that district, (2) cement tanks, and (3) earth reservoirs lined with oil, or with a plaster of one-half or three-quarters of an inch in thickness.

The Earth Reservoir is located either upon the highest point of the acreage to be watered and as determined by a level, or in such a position that the small portion lying above the basin can be irrigated direct from the motor driven equipment, and is constructed by the rancher with his own stock or by contract. Those built according to specifications and by contract are generally superior, as much care is exercised (1) in the preparation of the site and (2) in constructing the banks to eliminate erosion.

Earth basins are completed in periods of from five to seven days with a four-horse team and Fresno. Practically all of the soil being carried over that previously dumped, insuring solid banks even prior to settling noted after the basin has been placed in service. The ordinary basin is scaled either by puddling with clay, adobe or manure. Care, however, being exercised to retain a sufficient quantity of water in the basin to at all times cover the bottom—eliminating fissures.

The expense of the basin varies somewhat according to the capacity. A basin with inside dimensions of 120x120x5 ft., clay sealed, and holding four hundred fifty thousand gallons, was constructed by contract for one hundred twenty-five dollars, while another, 150x150x5 ft., and with a capacity of seven hundred fifty thousand gallons, cost only one hundred forty seven dollars, though in each case the banks were fourteen feet at the base and three feet six inches at the top.

Cement Tanks.—Considered essential for the storage of water prior to the advent of the contracted oil sealed earth basin possess no advantage, except permanency perhaps commensurate with the extra first cost for materials, including reinforcing and labor. Gravel and cement must be purchased, forms built, and when cured the interior must be painted or treated to a bath of heavy oil to prevent seepage. Cement basins should be banked around the exterior with earth, providing support for the walls, which usually taper from a width of four inches at the top to six inches at the base. A circular basin four feet high and seventy-five



An Oil Spray Bath

Oiled Basin Showing Discharge Pipe

feet in diameter was constructed in 1915 at San Jacinto, at an expense of three hundred eighty dollars, and stores one hundred twenty-five thousand gallons of water. A small, direct connected plant, consisting of a five horsepower Crocker-Wheeler motor and a two inch horizontal Byron Jackson pump, was placed in a pit six by eight feet at a depth of forty feet, and delivers one hundred forty gallons of water per minute against a total head of with an input at the meter of five horsepower. The direct connected equipment, in conjunction with the basin, provides ample water for the thorough irrigation of twenty-three acres of alfalfa and four acres of garden truck at an expense of two hundred fifty dollars per year, payable in twelve equal monthly installments each of twenty dollars and eighty-five cents. The plant displaced was a three and one-half inch vertical pump belted to a fifteen horsepower Fairbanks-Morse engine.

Earth Basins.—Constructed in light or sandy soils are rendered water tight, first by applying a coat of cement or lime plaster around the inside of the basin, or second, by spraying on the bottom and sides of the reservoir eighty or ninety per cent of asphaltum base oil. The plaster lining should vary in thickness from one-half to one inch and only be applied after thoroughly tamping and settling the soil. Prior to plastering two inch mesh, chicken wire reinforcing can be advantageously spread over the bottom and sides of the basin, which can be plastered at an expense of six cents per square foot.

Storage basins with gravel or sand have been made water tight by spraying the interior of the basin with a heavy asphaltum base oil, applied under pressure and at the rate of one-half to three-quarters of a gallon per square yard of surface oiled. The oil is delivered by motor truck and in twenty-five barrel lots at a temperature of three hundred degrees or more and fluxes readily with the well-rolled surface. After oiling screenings are scattered over the surface, forming a flexible lining not affected by climatic or temperature conditions. Oil was purchased in 1916 at an average price of two dollars and fifty cents per barrel of forty-two gallons, though in accordance with the decree affecting all raw and refined products, oil has advanced to three dollars and fifty cents per barrel delivered within a radius of sixty miles of the pit.

The basin shown in the figures required seventy-five barrels of oil for sealing, at an expense of one hundred sixty dollars, and an outlay of one hundred forty-seven dollars for construction. The gates, inlet and discharge pipes cost thirty-three dollars, or a total for the completed basin of three hundred fifty dollars. The basin has a capacity of eight hundred thousand gallons, and is operated in connection with a direct connected plant consisting of a 25 h.p., 440 volt, 3 phase Westinghouse motor and a special four inch Byron Jackson pump, delivering sixty-two inches of water against a head of eighty-five feet, with an input at the meter of twenty-three and one-half horsepower, or a plant efficiency of fifty-two and one-half per cent.

The direct connected equipment installed in a six by eight redwood pit, at a depth of sixty-nine feet, displaced a belt driven seven inch vertical pump and a sixty horsepower motor. Ninety acres of alfalfa and twenty acres of grain were advantageously flooded from the basin in 1916.

The oil required varies with the character of the soil, as was demonstrated by the construction of a basin 150x150x5 ft. Here gravel was encountered and one hundred and ten barrels of oil were sprayed on and worked into the bottom of the basin before rendering it water tight. The basin, erected at a cost of one hundred eighty dollars, and sealed at an expense of two hundred seventy-five dollars, is filled to a depth of four feet in thirty-four hours, at the rate of three hundred thirty-three gallons per minute, or thirty-seven inches delivered by a special four inch Byron Jackson direct connected equipment installed in a pit sixty-five feet deep, with an input at the meter of twelve horsepower. While only seventy acres of alfalfa were irrigated the past season, one hundred and ten acres can be thoroughly flooded merely by changing the runner in the pump at such a time as the demand for water increases.

As additional acreage is placed under cultivation in Southern California and the experience of the successful rancher is given consideration, it seems reasonable that the forty-five basins now in satisfactory service in the territory served by the Southern Sierras Power Company, and lasting monuments to the cooperation of utility and consumer, will be increased many fold.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER

(Alternating current motors are constantly displaying defects in their stator windings; the rapid growth in use of the electric range necessitates information on the replacing of switches; and the price at which goods are to be sold at a reasonable profit is a question of daily worry with the contractor and dealer. Here are timely discussions of these subjects by the power apparatus specialist of a well-known electrical supply house in San Francisco that should receive grateful consideration from the contractor and dealer perplexed by problems of this nature.—The Editor.)

ALTERNATING CURRENT MOTOR TROUBLES

Defects in Stator Windings

In this article only those defects in the stator winding which particularly affect motors during the starting period will be enumerated. The discussion will apply equally well to squirrel-cage or slip-ring type motors since the same general form of winding is used in both types, whether the motor be designed for a two or three-phase circuit.

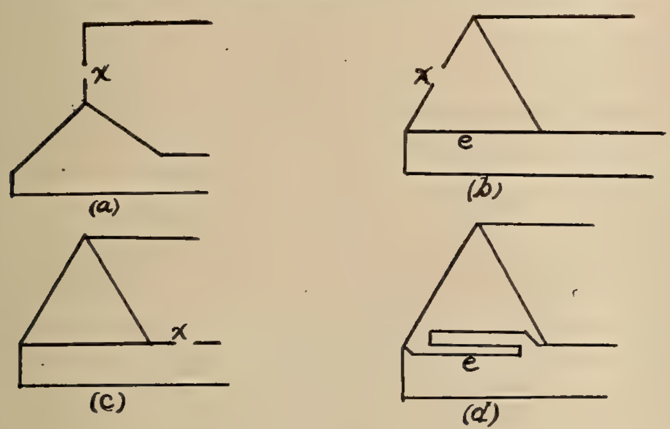


Fig. 1. (x denotes open circuit)

The most common winding faults are short-circuits, open-circuits and grounds. Once in a while a reversed phase will be found or perhaps only a few coils in a phase will be reversed. These faults are not often found in new machines as they are usually detected by the factory inspector or test department. Troubles due to wrong connections are easily found by inspection of the windings but the common troubles just given—short-circuits, open-circuits and grounds—are most always hidden from view and can only be detected by electrical tests.

An open circuit in one phase of a two-phase motor will leave the motor without starting torque. Hence, it will not start by itself. The same statement will apply with both phases open. When occurring in three-phase machines, the effect of an open circuit in one phase will depend entirely upon the way in which the stator is connected. With a Y-connected machine, Fig. 1 (a) this fault will leave the motor with single-phase excitation, therefore without starting torque. As in case of the two-phase machine, the motor will not start. In a delta-connected machine, the effect is different. An open circuit in one phase as shown by Fig. 1 (b) will give an open-circuited delta excited by three-phase current. The winding, in this condition, will produce a revolving magnetic field and accordingly develop a starting torque but the value of this torque will be much lower than that produced with all phases of the winding active. Should the starting torque of the motor in normal condition be just sufficient to start its load, the motor would probably not start at all. It would start, however, without load.

In a delta-connected machine, with one lead open between the terminal board and junction of the winding, as in Fig. 1 (c) the motor will receive only single-phase excitation and as before, will be without starting torque.

As just shown, single-phase excitation will not produce a starting torque in either a two or three-phase machine. However, if a motor excited in this manner is brought up to speed mechanically, it will continue to operate single-phase and will carry approximately 50 per cent of its normal full load. A three-phase motor operating in this manner will take at any load approximately 175 per cent of the corresponding three-phase current.

When a motor will not start unaided it is then well to give it some mechanical assistance. Should the rotor show a tendency to come up to speed in either direction it will indicate an open circuit in one phase of the winding or in one of the lead wires if a delta-connected stator. This condition is easily detected by reason of the peculiar humming noise due to the single-phase excitation of the windings.

A short-circuited coil will ordinarily not prevent starting but will cause excessive heating after the machines has been in operation a while. On the other hand, if a large torque is required from the motor and a number of coils happen to be short-circuited, it is likely the motor will not start at all. Likewise, a three-phase motor with one phase of the stator reversed, will have a greatly reduced starting torque and will probably not start except without load. When the motor is running the stator currents will be badly unbalanced and will also produce a marked humming and buzzing noise. At this point note carefully that in this discussion a reversed phase refers to the actual reversing of one complete phase of the winding and not to simply reversing one phase by interchanging two of the external leads as would be done in order to reverse the direction of rotation of the motor. This will be clear by referring to Fig. 1 (d) which shows phase e in Fig. 1 (b) reversed.

Grounds in the stator may also give much trouble, depending upon their number and position in the winding. Two grounds in the same machine will often short-circuit a considerable portion of the whole winding and thereby prevent starting. If the frame of the machine is also grounded, as is now generally the case, then only a single ground in the winding may be suf-

ficient to make trouble. This is possible when the secondary circuits are grounded as a ground in the stator may act as a short-circuit across the supply service.

Additional articles on motor troubles will appear in later issues. The next one will deal with rotor or secondary circuit troubles.

REPLACING SWITCHES ON RANGES

The question as to whether or not the heating unit in an electric range could be burned out by incorrectly connecting its controlling switch recently came up in connection with a complaint covering a unit which burned out almost immediately after a broken switch had been replaced. A little study will show that the connections, even though incorrectly made, could not possibly cause this trouble.

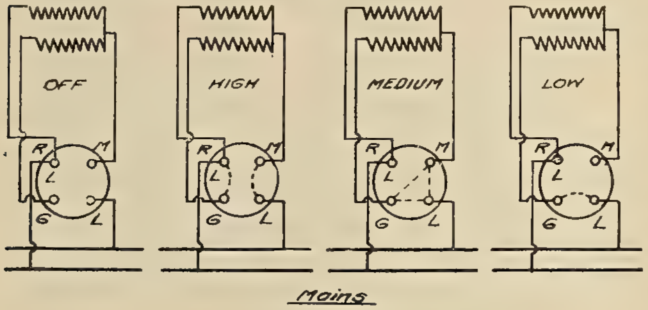


Fig. 2

The switches for this purpose are known as the series-parallel type and are arranged for an off position and for three heats, high, medium or low. These can also be supplied to effect the changes in the reverse manner, low, medium or high. The first scheme of operation seems most logical for range work as it allows the units to come up to full heat on the first step. Connections for the well known "Diamond H" switch used extensively for this service are shown in Fig. 2. which is taken from the manufacturers' catalog. From these diagrams it will be seen that in the high position both sections of the unit are in parallel across the mains—thus giving the maximum heat. Both sections are then working at normal voltage. In the next position one section only is burned at full heat, the other being short circuited by the switch contacts and carrying no current..

In the last or low position, both sections of the element are in series across the mains—thus giving minimum heat. This explanation shows that it is impossible to place more than normal voltage across any one section of the unit no matter how the switch is connected. Therefore, wrong connections could not cause the unit to be destroyed.

On the contrary, if the connections are not right the mains may be short-circuited. For example, assume that the switch instead of being connected as shown in the diagram is rotated 90 degrees to the right—then the right lead will connect to contact M instead of L, and so one. With this connection the mains will be short-circuited by the switch when it is thrown to the first closed position—that is to high heat. Rotating 180 degrees from the original position, however, does not produce a short circuit and will allow the units to heat up in one position, but rotating the switch another 90 degrees again produces a short-circuit. So it will be clear that caution must be taken in changing the switch. Mistakes will not be made if the position of the indicator on the switch is noted. It is customary to place the off position at the top.

When changing switches care must be taken not to alter the connections between the cutout and switch. Most ranges are wired for 3-wire service and when used in this way there is a possibility of double voltage being thrown across some of the units if the connections at the cutout are not correct. For the same reason, when changing a range from 2-wire to 3-wire service or vice versa the connections should always be carefully checked.

SOMETHING ABOUT PRICES

Many electrical dealers do not keep their selling prices in get-at-able shape. You will appreciate what we mean, Mr. Dealer if you have ever studied the manner in which some of them handle their customers. When asked for prices they are frequently obliged to look through perhaps several catalogs or even hunt through a lot of miscellaneous letters, folders or advertising matter in an endeavor to find the latest price or discount. Then they are often obliged to estimate the parcel post or other carrier charges. All of this delay along with the excuses they will probably make for not having the prices at their finger tips creates a bad impression on the customer. In fact the customer could not be blamed if he became suspicious and wondered if the dealer really did know the prevailing market prices. Very often after such experiences the customer will want to shop around a bit and will ninety-nine out of one hundred times place his business elsewhere.

Now, Mr. Dealer, if you have been guilty of such practice it will pay you to give these points careful thought and to put your prices into more usable shape without delay. It is surprising how little time this requires, especially for the small store and how convenient it is to have all devices and materials properly tagged or marked with prices.

Begin first by marking all devices upon which there is an established advertised selling price, such as irons, toasters, sewing machine motors and the like. If price tags are furnished by the manufacturer always use them in preference to others. If not keep close at hand or on display literature or advertisements in which the selling prices are shown. Such evidences of standardized selling prices always have a convincing effect upon the customer.

Next arrange your prices on such material as dry batteries, flash lamp batteries, fuses, extension cords, repair parts for heating devices or such other material as is usually kept in bins or on shelves. An easy way to do this is to tack a card in the bin or in some convenient position. Be sure, however, to make the changes promptly upon advice of market changes. This is a scheme followed out extensively by hardware stores. It is convenient, inexpensive and easily kept up.

WESTERN ELECTRICAL ASSOCIATION MEETINGS

(Plans for the approaching convention of the Pacific Coast Section of N. E. L. A. are proceeding apace. From present indications this will be the largest and most enthusiastic assemblage of men of the electrical industry on the Pacific Coast thus far accomplished in the history of Western enterprise. The latest announcements of interest to the membership will be found in the following lines.—The Editor.)

PACIFIC COAST SECTION, THE LARGEST GEOGRAPHICAL SECTION OF N.E.L.A.

The Pacific Coast Section is already the largest geographical section of the National Electric Light Association and before the convention in April at least 1000 members will be enrolled. The Southern California Edison Company, alone, is responsible for 329 of these members and other companies are rapidly responding to the efforts of the energetic membership campaign.

Great enthusiasm and interest is being evinced in the first annual convention of the Section at Riverside, April 19-21. All convention papers and reports will be printed in advance in these columns and be distributed to the members prior to the meeting. This should insure first class discussion and will obviate the necessity for taking the time of the meeting to read the papers.

The convention committee, under the chairmanship of A. B. West, met at Los Angeles, March 17th to complete final arrangements for the convention.

Location of Class A Members, Pacific Coast Section, N. E. L. A.

The tentative program has already been printed in these columns. At the banquet on Friday evening, in addition to the report of the public policy committee, there will be addresses by Max Thelen, President of California Railroad Commission; John S. Mitchell of the Los Angeles Chamber of Commerce; O. B. Coldwell, representing Northwest Electric Light & Power Association, and H. M. Byllesby of Chicago.

The following circular, which is reproduced in miniature, has been sent to all members:

All Aboard for Riverside Convention—Pacific Coast Section National Electric Light Association, April 19-21, 1917.

You are invited and expected to attend the first annual convention Pacific Coast Section N. E. L. A. Every provision has been made for your instruction, entertainment and convenience. We need your co-operation as regards the following details:

Early advance registration is important. Now is the time to fill out and return the card accompanying this announcement.

Transportation arrangements provide for 1 1-3 fare for the round trip to Riverside from all points in California, Nevada, Arizona and New Mexico. This is on the receipt certificate plan and requires a minimum attendance of 50 delegates. When you buy your full fare, one way ticket to Riverside get a receipt certificate from your railroad agent for validation at Riverside. Through tickets must be purchased at initial point to secure the benefit of the one-third fare returning. In California tickets will be on sale for the going trip April 17-21, inclusive, and certificates will be honored for return April 19th to 23d inclusive. From points outside of California sales dates will be one day earlier.

A special car to the convention will leave San Francisco at 5 p. m. April 18th on the Sunset Limited, joining cars from Los Angeles on the morning of the 19th, to form a special train to Riverside. Other special trips will be announced subsequently.

Special baggage tags will be supplied to all delegates registering in advance. These will accelerate delivery of trunks to guests' rooms.

Hotel accommodations have been reserved at the Glenwood Mission Inn, the convention headquarters, and at the Hotel Reynolds. The rates of the former are $5 per day with bath, $4 without, American plan. At the latter the rates are $1.50 per day and up, European plan. The Hotel Tetley also can accommodate fifty at $1 per day and up The Glenwood Mission Inn has facilities to care for all.

Please return attached post card at once.

CONVENTION COMMITTEE.

The Engineering Committee, J. E. Woodbridge chairman, met at San Francisco on March 22d, and at Los Angeles on March 23d. As a result of these meetings the following reports will be presented for discussion:

Standardization of Distribution Transformers;
Report of conferences with Engineers of California Railroad Commission on General Safety Order affecting Line Construction;
Suspension Insulators;
Standardization of Pin and Clevise Hardware for Suspension Insulators.

E. B. Strong, master of transportation at San Francisco is trying to get up a special train to Riverside from San Francisco with every present assurance of success. At Los Angeles, E. R. Northmore is doing likewise.

The Commercial Committee, S. V. Walton, chairman, met at Los Angeles, March 17th and thoroughly discussed all reports to be presented at the meeting. In addition to the exhaustive report of tests on electric water heaters (as printed elsewhere in these columns) the following reports will be submitted for discussion at two sessions of the convention:

Rates, Merchandising of Lamp Socket Devices.
Electric Cooking and Water-Heating.
Highway Lighting.
Industrial Electric Heating.
Commercial Organization.
Inductive Interference;
Fuse Protection of Transformers and Branch Lines in Rural Distributing Systems;
Joint Pole Construction;
Operation of Steam Turbine Standby Stations;
High Head Water Wheels.

The Accounting Committee, B. F. Story chairman, will present its report Friday morning, April 20th.

An endeavor is now being made to interest the manufacturers, jobbers and dealers in the association. They are all eligible as Class D or E members and can derive much benefit from their membership. They will be particularly welcome at the convention.

NEVADA SUB-SECTION N. E. L. A.

Nevada members of the Pacific Coast Section of the National Electric Light Association organiized an informal sub-section of the Association at Reno on March 10th, with Geo. A. Campbell, general manager of the Truckee River General Electric Company as chairman and A. H. Halloran, managing editor of the Journal of Electricity, as secretary. The meeting had been called by Dean J. G. Scrugham as one of the features of Engineers' Day at the University of Nevada.

Chas. A. Brown, superintendent of the Truckee River General Electric Company, presided at the organization meeting. Dean J. G. Scrugham told of the recent organization of the Pacific Coast Section and suggested that various representative men express their views on the matter. Joe Bean, superintendent of the Nevada Valley Power Company at Lovelock emphasized the advantage of frequent local meetings in solving local problems. L. W. Crehore, superintendent of the Fallon Electric & Water Company, told of the benefits he had derived from the standardization of construction and accounting methods by the N. E. L. A. C. S. Young, superintendent of the Lovelock Power Company, spoke in favor of regular meetings of the Nevada power men, as did likewise B. G. McBride, manager of the Elko-Lamoille Power Company at Elko. F. O. Broili of the Northwestern Electric Company, at Portland, illustrated the value of such meetings by the successful experience at Portland. A. H. Halloran, managing editor of the Journal of Electricity, gave full details of the organization and plans of the Pacific Coast Section N. E. L. A., and also the Society for Electrical Development. Brief remarks were also made by Geo. R. Murphy of the Electric Storage Battery Company and C. M. Le Count of the General Electric Company. A resultion to form the sub-section was then adopted.

In the afternoon many visitors were entertained at the engineering shops and laboratories by working exhibits and demonstrations. These included electrical machinery, gas engines and pumps, testing of materials and an exhibit of the distillation and chemical utilization of sage-brush.

In the evening a transcontinental telephone demonstration between Reno and Washington was the crowning feature of the celebration. Prominent men of Nevada conversed with those of Washington, D. C. over the long distance telephone. A large gathering of townspeople "listened in" on the conversation.

APPLIANCE PLUG STANDARDIZATION

The wiring committee of the commercial section of the National Electric Light Association is considering the standardization of the connection of the cord to the lamp socket or wall receptacle, and also the connection of the cord to the device.

The connection of the cord to the lamp socket, etc., is the standardization of the attachment plug. The wiring committee has been at work on this for some time, but this is practically a separate question from the connection of the cord to the device. The latter question is the only one discussed in this notice, or to be discussed in the meeting noted below.

The wiring committee is so far firmly convinced of only one thing, which is that some time in the future there will be a standard form of connection so that a cord will fit the flat iron of different manufacturers and also will fit percolators, toasters, etc., of different manufacturers. It believes this development is as sure for the future as the present standardization of the Edison screw base for lamps.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Irrigation by spraying is new in the arid districts of the West, as is also the compilation of exact data concerning the necessary quantity of water required in the newly evolved industry of rice growing in California. Here are important digests on these two subjects of timely interest made by the author of this department who is a well-known irrigation specialist at the University of California. The pictures for rice growing have been furnished through the courtesy of Frank L. Adams, of the Department of Irrigation Investigations, U. S. Department of Agriculture.—The Editor.)

Typical Installation for Spray Irrigation in Orange Groves, Near Porterville, Cal

SPRAY IRRIGATION

The use of overhead spray systems of irrigation has been tried in a few instances for truck crops and citrus groves in California. Such methods of irrigation are as yet experimental, the advantages claimed are the more uniform distribution of water, reduction in labor cost in making furrows and irrigating, adaptation to rough or steep land, ability for plant roots in orchards to use the area between tree rows more effectively, and by using surface mulches to avoid cultivation. The disadvantages are the high cost of installation, the high cost of operation due to the pressure required to operate the spray system and the loss by evaporation in arid climates.

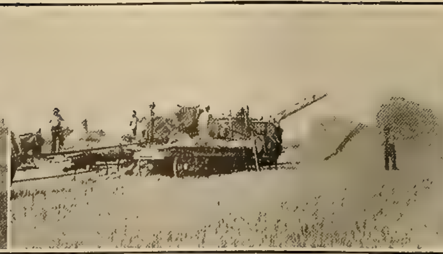
A bulletin descriptive of spray systems of irrigation as used in the East has been issued recently (Bulletin 495, U. S. Department of Agriculture, "Spray Irrigation," by Milo B. Williams). This bulletin describes the different methods used there with data regarding their equipment and operation. This bulletin states the cost of the field equipment of such systems may be as low as $50 per acre for portable outfits to $150 for stationary systems. To these figures must be added the cost of a main pipe line leading from the water supply to the fields and usually the cost of developing a water supply and installing a pumping plant. These items may bring the total cost to two or three times the figures given above for the distribution system alone. On the assumption of a first cost of $250 per acre, Mr. Williams estimates the annual cost of interest, depreciation, repairs and operation would be $51 per acre. It is recommended that a sufficient capacity to supply 1½ inches depth per week be provided in arid regions. Well water gives less difficulty from the clogging of the nozzles.

The overhead spray systems as used in citrus groves consist of lines of pipe supported on posts spaced about 50 ft. apart, or every other tree row. A single row of small holes fitted with small brass nozzles are fitted into the pipe. For citrus groves these pipes may be set on posts about 6 ft. high and 15 to 20 ft. apart, or they may be supported from a cable carried on high posts spaced from 100 to 200 ft. apart.

To generate a spray requires a pressure of 25 to 40 pounds on the nozzles in addition to conveying and elevating the water in the field. Owing to the greater cost of the main pipe lines used for such systems than of the concrete lines usual in the low pressure systems for furrow irrigation, Mr. Williams recommends using sizes which give friction losses of from 3 to 4 ft. per 100 ft. of line.

These general figures for eastern conditions furnish a basis for approximately the conditions which such systems must meet in California. The cost of installation will be as high as the figures given. If 600 ft. of pipe is required, with the nozzle lines 10 ft. above the ground and 30 pounds pressure at the nozzle line is maintained, a total pressure equal to a lift of from 90 to 100 ft. will be required, that is such systems represent cost of installation of $200 per acre with a condition of operation equivalent to a lift of 100 ft. above the lift required for other methods. Such conditions will limit the use of spray irrigation to those particular conditions and crops where the returns will justify the expense. These conditions may occur in California for intensive truck or nursery practice and possibly for citrus fruits, although their use for the latter crop is questionable.


Crowder for Building Levees


Threshing Rice


Harvesting Rice

DUTY OF WATER FOR RICE GROWING

Approximately 64,000 acres of rice were irrigated in the Sacramento Valley in 1916, as shown in a report of measurements of duty of water for rice in the Sacramento Valley by Ralph D. Robinson, irrigation engineer, recently issued by the California State Water Commission. Of this area approximately 29,500 acres were irrigated from the Sacramento River, 24,000 acres from the Feather River, 8800 acres from minor streams and 1700 acres with water pumped from wells. The first commercial crop of rice in California was grown in 1912 on 1400 acres. The area in 1916 was over twice that planted in 1915.

Measurements were made of the water used on 18 representative fields located on both sides of the valley. The area of these fields varied from 14 to 1100 acres, the total area being 3300 acres. Ten different soil types were represented.

Where water was wasted or drained from a field an attempt was made to measure or estimate the quantity removed. In many cases there was considerable seepage through the outside levees into adjacent sloughs which could not be measured and again in some instances the levees were not sufficiently high to prevent water flowing over the tops into neighboring fields or roads. Probably 1/3 to 1/2 of the water applied to some fields was lost in this manner.

Another factor which enters into the use of water is the depth to ground water. Where the water table was about one foot below the surface as in the case of fields near Biggs, the amount applied was much less than in fields near Willows or Marysville, where the water table was 3 to 12 ft. below the surface. Aside from the proximity to sloughs, depth to water table and manner of irrigating rice, the character of the soil and the preparation of the land play an important part in the use of water.

The minimum amount of water used on any field was 4.27 acre feet per acre on the Adams field on Stockton clay adobe near Biggs. The maximum net amount used was 14.83 acre feet per acre on the Johnson No. 1 field on Willows loam and Willows clay adobe near Willows. The average depth applied to the 18 fields was 8.23 feet exclusive of waste.

None of the canal companies in Sacramento Valley, with the exception of the Yolo Water & Power Company, which charges $1.50 per acre foot for water, have as yet sold water on an acre foot basis.

The Sacramento Valley West Side Canal Company, by authority of the Railroad Commission, charged $7 per acre for rice irrigation. For this charge the water user was entitled to 5 acre feet of water per acre and additional amounts were to be charged for at the rate of $1.50 per acre foot. However, no cases are known where charges were made on an acre foot basis. The Sutter-Butte Canal Company has furnished water to lands having water rights at $5 per acre. Recent contracts made by the company are on the basis of $7 per acre with reimbursements to the water user for the construction of ditches and procuring of rights of way, providing water has been used for more than two successive years. The amount of water called for in their contracts is on the basis of 1 cubic foot per second for each 53 1/3 acres.

The irrigation season for rice in Sacramento Valley is divided into two periods. In the first period the rice is irrigated from 4 to 8 times without having water stand on the field. When the rice is about 6 inches high, which is from about 4 to 6 weeks after planting, the fields are kept submerged about 6 inches deep until the rice is matured. When the heads are turned down and properly filled, the water is removed from the field to permit of harvesting. With one exception, all of the fields studied in 1916 were planted to Wataribune rice, which is the most widely planted variety in California. The total length of the irrigation season varied from 155 to 189 days. A variety of Japanese rice known locally as California Pearl on the Dodge Rice Company tract required only 147 days to mature.

Rice fields are laid off in contour checks ranging from 2 to 5 or more acres in extent. A few years ago the levees were made with Fresno scrapers, but the common practice now is to throw them up with a large checker or crowder drawn by a tractor.

The Sutter-Butte Canal Company, which takes its supply from the Feather River about 10 miles above Gridley, served the largest area of rice, amounting to 17,000 acres. The Western Coal Company, which heads on the Feather River shortly above the Sutter-Butte Canal, served 5500 acres. The lands served under these two systems are classified by the Bureau of Soils as Stockton clay adobe. The Sacramento Valley West Side Canal supplied water to 8500 acres in Glenn and Colusa counties. A striking feature here was that considerable land locally known as "goose land" and which had heretofore been unutilized except for scanty pasture, was planted to rice.

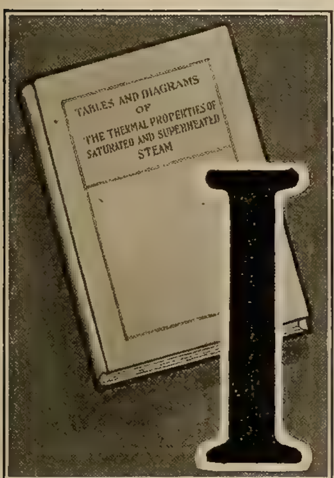
The average gross depth of water used prior to submergence is 1.78 ft. and during submergence 7.92 ft. on 15 fields for which the detail is given. The average measured waste from the 18 fields is 1.02 acre feet per acre. The average area served per second foot of water during the period of submergence is 40 acres, varying from 18 to 70 acres for the different fields. Of the 18 fields only 3 that were investigated received less than 5 acre feet and 5 exceeded 10 acre feet per acre.

FUEL OIL AND STEAM ENGINEERING

(Steam tables are to fuel oil and steam engineering practice what the letters of the alphabet are to English composition. They are the working tools whereby the engineer is enabled to make quick and accurate expression of facts pertaining to power plant economy. Here is a discussion of the well-known Marks & Davis steam tables that should enable the student in fuel oil and steam engineering study to make use of this valuable weapon in computation of test data.—The Editor.)

THE STEAM TABLES IN FUEL OIL PRACTICE

BY ROBERT SIBLEY



The Book of Steam Tables

IT has already been shown that since no simple mathematical laws have as yet been devised to express the temperature, pressure, latent heat, heat of liquid and other fundamental properties of steam and water that are absolutely necessary in the solution of steam engineering problems, we must resort to carefully compiled steam tables.

Practically all the research and scientific investigation along the lines of pure steam engineering of the last half century have been devoted to the more complete establishment of some of the fundamental constants involved in the steam tables.

The three most important of these are the zero point of the absolute temperature scale, the proper value for a constant employed in the conversion of mechanical energy into heat energy, and the exact determination of the heat required to evaporate one pound of water from 212° F. into dry saturated steam at 212° F.

Since these values are continually found by more careful and exacting experimental work to be slightly different than formerly held, we find that the steam tables of recent publication are different than those of former years.

The Steam Tables as Adopted in this Discussion.—The Steam Tables and Diagrams as computed by Marks and Davis and published by Longmans, Green & Company are today universally recognized and are adopted as the standard compilation for the problems cited in this discussion.

In the rear of these steam tables an interesting discussion of the methods employed by these investigators in arriving at the three fundamental constants mentioned above is given. The result of these investigations shows that the absolute zero is to be taken at 459.6° F., the mechanical equivalent of heat at 777.5, and the latent heat of steam at 212° F. to be 970.4 B.t.u.

Recapitulation of Fundamental Evaluations.—These three constants are so important that they should be memorized and for emphasis let us recapitulate their exact interpretation.

The absolute zero is now found to be a point situated at 459.6° F. below the zero point on the Fahrenheit scale or 491.6° F. below the freezing point of water. At such a temperature it is supposed to be impossible to further draw off heat from any substance for at this temperature the heat storage is supposed to be absolutely exhausted.

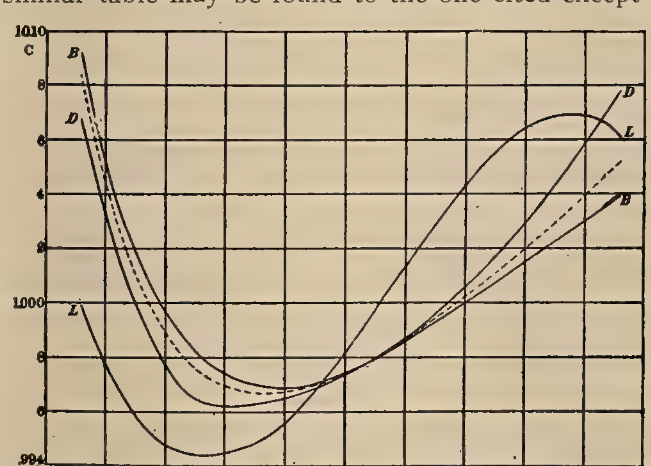
The mechanical equivalent of heat as given above means that the energy represented by one B.t.u. or British thermal unit of heat is equivalent to 777.5 ft. lb. of mechanical energy. Or if one pound of crude petroleum contains 18,500 B.t.u., it possesses as stated in a previous chapter, sufficient energy to raise a human being weighing 175 lb. a vertical upward distance of over 18 miles.

The latent heat of steam at 212° F. and atmospheric pressure means that the quantity of heat necessary to evaporate one pound of water at 212° F. into dry saturated steam at 212° F. is found experimentally to be 970.4 B.t.u.

Analysis of a Typical Page of Steam Tables.—Let us now proceed to analyze a page of Marks & Davis' steam tables, column by column. The illustration as given is found on page 12 of this compilation and we shall follow across the page the line corresponding to a temperature of 231°F.

Temperatures in Fahrenheit Units.—Since all steam engineering computation is based on temperatures represented in the Fahrenheit scale instead of the Centigrade system, the temperatures are here listed in the Fahrenheit units.

Pressures in Absolute Notation.—This column means that the pressures here given represent the pressure in pounds per sq. in. at which water will boil when the temperature is that as listed in the first column. Further on in the steam tables an exactly similar table may be found to the one cited except in



Marks & Davis Method of Collating Data for Specific Heat of Water from Three Noted Investigators

Table 1: Temperatures

Temp. Fahr.	Pressure lbs.	Pressure Atmos*	Sp. Vol. cu. ft. per lb.	Density lbs. per cu. ft.	Heat of the liquid	Latent heat of evap.	Total heat of steam	Internal Energy B. t. u. Evap.	Internal Energy B. t. u. Steam	Entropy Water	Entropy Evap.	Entropy Steam	Temp. Fahr.
t	p	—	v or s	1/v	h or q	L or r	H	I or ρ	E	n or θ	L/T or r/T	N or φ	t
230°	20.77	1.413	19.39	0.0516	198.2	958.7	1156.9	884.3	1082.4	0.3384	1.3905	1.7289	230°
231	21.16	1.440	19.05	0.0525	199.2	958.1	1157.2	883.6	1082.7	0.3399	1.3875	1.7274	231
232	21.56	1.467	18.72	0.0534	200.2	957.4	1157.6	882.8	1083.0	0.3414	1.3844	1.7258	232
233	21.96	1.494	18.40	0.0543	201.2	956.7	1158.0	882.1	1083.2	0.3429	1.3814	1.7243	233
234	22.37	1.522	18.09	0.0553	202.2	956.1	1158.3	881.3	1083.5	0.3443	1.3784	1.7227	234
235°	22.79	1.550	17.78	0.0562	203.2	955.4	1158.7	880.6	1083.8	0.3458	1.3754	1.7212	235°
236	23.21	1.579	17.47	0.0572	204.2	954.8	1159.0	879.8	1084.0	0.3472	1.3725	1.7197	236
237	23.64	1.609	17.17	0.0582	205.3	954.1	1159.4	879.1	1084.3	0.3487	1.3695	1.7182	237
238	24.08	1.638	16.88	0.0592	206.3	953.4	1159.7	878.3	1084.5	0.3501	1.3666	1.7167	238
239	24.52	1.668	16.60	0.0602	207.3	952.8	1160.0	877.6	1084.8	0.3516	1.3636	1.7152	239
240°	24.97	1.699	16.32	0.0613	208.3	952.1	1160.4	876.8	1085.0	0.3531	1.3607	1.7138	240°
241	25.42	1.730	16.05	0.0623	209.3	951.4	1160.7	876.1	1085.3	0.3546	1.3578	1.7124	241
242	25.88	1.761	15.78	0.0634	210.3	950.7	1161.1	875.3	1085.6	0.3560	1.3550	1.7110	242
243	26.35	1.793	15.52	0.0644	211.4	950.1	1161.4	874.6	1085.8	0.3575	1.3521	1.7096	243
244	26.83	1.826	15.26	0.0655	212.4	949.4	1161.8	873.8	1086.1	0.3589	1.3493	1.7082	244

A Typical Page from the Steam Tables

this latter instance the pressures are made to vary pound by pound and the corresponding boiling temperature of water given.

In this instance, then, we read that a pressure of 21.16 lb. per sq. in. is necessary in order to make water boil or begin the formation of steam at 231° F. This pressure, by the way, is in absolute units and would not be the pressure read on the steam gage of a boiler room. Since the steam gage indicates pressures above the atmosphere, one must subtract from this reading in the steam tables the atmospheric pressure of the day in order to find the proper gage pressure. Thus, in this instance, if the atmospheric pressure of the day be 14.7 lb. per sq. in., a steam gage in a boiler room would read 6.46 lb. per sq. in., when the water in the boiler is 231° F.

This precaution is most important and the student should carefully reread the former chapter on pressures if he does not thoroughly understand the conversion of gage pressures, inches of vacuum, inches of mercury, etc., into standard absolute pressure units.

Pressures in Atmospheres.—In many engineering computations pressures are given as so many atmospheres instead of pounds per square inch. The pressure of the standard atmosphere is usually taken as 14.7 lb. per sq. in. but for very exact work it is more accurately 14.696 lb. per sq. in. Hence this column is computed by dividing each item in the preceding column by 14.696, which in this instance is found to be 1.440 atmospheres.

When, however, the reading is below that of ordinary atmospheric pressure, such values are often desired in inches of mercury since vacuum pressures for the condenser are given in such units. This particular column is there found by dividing the corresponding line in the preceding pressure column by the number of inches of mercury equivalent to one pound pressure per square inch. It is to be remembered that this does not even yet give the reading in inches of vacuum. Pressures in absolute inches of mercury, and inches of vacuum cause seemingly endless confusion. A complete discussion of this feature was taken up under the chapter on pressures and its careful review is emphatically recommended if any unsettled question still exists in the mind of the reader.

Specific Volume.—The cubic feet occupied by one pound of dry saturated steam at a given temperature and pressure is known as the specific volume of the steam for that temperature and pressure.

This is a factor often necessary in steam engineering computations. Yet no known means has ever been invented whereby this factor can be accurately ascertained by experiment. The task is indeed one that involves such difficulties as to make its determination by experiment practically impossible. The science of higher mathematics has come to the rescue and here is indeed an instance where purely theoretical deductions have brought about a practical solution of an otherwise unsolvable problem in steam engineering

This relationship involves the latent heat of evaporation **L**; the absolute temperature **T** at which the saturated steam is formed; the ratio of the increase in pressure Δp to the increase in temperature Δt of boiling points taken immediately below the temperature under consideration and immediately above it; the specific volume of the steam **v** that is found, which of course, is the unknown value we are desirous of computing; and the specific volume of a space occupied by one pound of water v_1 immediately before its conversion into steam. Algebraically the relationship is expressed thus:

$$L = T\left(\frac{\Delta p}{\Delta t}\right)(v - v_1) \quad \ldots\ldots\ldots\ldots (1)$$

From the steam tables we will take our values for Δp and Δt immediately below corresponding to 230° F. and immediately above corresponding to 232°F. Hence

$$\Delta t = (232 - 230) = 2.$$
$$\Delta p = (21.56 - 20.77)\ 144 = 0.79 \times 144 = 114.$$
$$T = 231 + 459.6 = 690.6.$$
$$L = 958.1 \times 777.5.$$
$$v_1 = .016 \text{ cu. ft.}$$

Substituting, we have

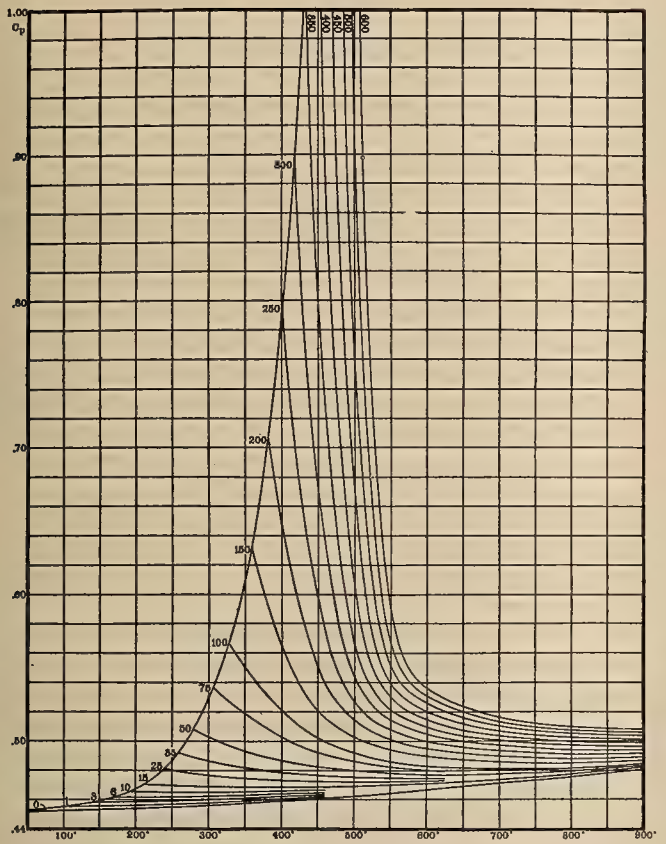
$$958.1 \times 777.5 = 690.6\left(\frac{114}{2}\right)(v - .016)$$

$$\therefore v = 18.98$$

The value in the table is 19.05 which is seen to be about one-third of one per cent in error. This difference is probably due to the fact that decimals neglected in computation were made use of by the compiler of the steam tables, and then too the small pressure and temperature variations were probably taken nearer together than is possible in the data actually set forth in the steam tables.

Specific Density.—The weight in fractions of a pound of one cubic foot of dry saturated steam is known as its specific density.

It is evident that if one pound of steam occupies 19.05 cu. ft. as taken from the previous column, then 1 cu. ft. of steam would weigh 1/19.05 of a pound which is 0.0525 lb. Hence this column is computed in each case by taking the reciprocal of the data given in the preceding column.



Determination of the Specific Heat of Superheated Steam from Investigations of Knoblauch

The Heat of Liquid.—This is one of the most important columns necessary in steam engineering practice. Since the heat of liquid technically means the quantity of heat necessary to raise one pound of water from 32° F. to the temperature under consideration, it is evident that by experimental data as given in this column it has been found that to raise one pound of water from 32° F. to 231° F., 199.1 B.t.u. are necessary to be applied from an outside source.

The Latent Heat of Evaporation.—Data for the latent heat of evaporation has been determined by careful experimental means. It is by definition the quantity of heat necessary to convert one pound of water at the temperature and pressure indicated into dry saturated steam at the same temperature and pressure. In this instance it is seen that to convert one pound of water at 231° F. into dry saturated steam at 231° F., 958.1 B.t.u. are necessary to be applied from an outside source.

Total Heat of Dry Saturated Steam.—The total quantity of heat required to raise the temperature of one pound of water at 32° F. to the temperature at which dry saturated steam may exist under the pressure excited in the particular instance, added to the quantity of heat then necessary to convert this water completely into dry saturated steam is known as the total heat of dry saturated steam. Numerically speaking, it is seen that this column is at once obtained by adding the heat of liquid and the latent heat of evaporation. In a word, this column is the sum of the two preceding columns. Thus

$$H_{231} = h_{231} + L_{231} \quad \ldots\ldots\ldots (2)$$

$$\therefore H_{231} = 199.1 + 958.1 = 1157.2.$$

Internal and External Work.—One wonders where the heat disappears when it is being continually applied to water at the boiling point and yet the temperature of the water or steam does not increase.

Upon careful investigation it is found that it disappears first in an internal absorption due to intermolecular rearrangement as water passes into steam which thereby stores up a considerable quantity of energy to be given out again when the steam is condensed back into water. The energy that disappears in this manner is known as energy necessary to perform internal work.

On the other hand in the generation of steam from water the volume is vastly increased. The pushing back against external pressure to make room for such an increased volume performs external work. So that the energy applied in steam generation which goes toward latent heat of evaporation may be divided into two classifications, known as external and internal work.

No one has as yet found a method of directly measuring internal work. We may, however, measure external work or even compute it and then by subtraction from total energy absorbed arrive at a value for internal work.

In a former chapter on gases it was shown that the external work accomplished by a gas expanding under constant temperature and pressure is computed universally by subtracting the initial volume from the final volume and then multiplying this result by the pressure. Thus

$$\text{Ext. Work} = p\,(v - v_1)$$

To convert this into B.t.u., we have

$$\text{Ext. Energy} = \frac{p\,(v - v_1)}{777.5} \quad \ldots\ldots\ldots (3)$$

From the tables it is seen that in this instance $p = 21.16 \times 144$, $v = 19.05$, $v_1 = .016$.

$$\therefore \text{Ext. Energy} = 21.16 \times 144\,(19.05 - .016)$$
$$= 74.6 \text{ B.t.u.}$$

$$\therefore \text{Internal Energy} = 958.1 - 74.6 = 883.5 \text{ B.t.u.}$$

Entropy of Water.—In certain advanced problems in steam engineering, engineers and physicists have found it convenient to invent fictitious qualities of steam. While many have endeavored to give a physical interpretation of entropy, perhaps it is clearer for the student to consider it as merely a mathematical fiction which, however, often becomes extremely useful for the representation of steam engineering problems and indeed assists wonderfully in their solution.

On this assumption, entropy may be defined as such a quantity that when plotted against absolute temperatures the area under the curve connecting all

such points will numerically represent the amount of heat supplied to one pound of matter in order to accomplish the indicated change in temperature. Thus in the instance at hand if one should plot a curve with ordinates representing absolute temperatures and with abscissas representing the entropy for each corresponding temperature, the area under this curve would be exactly 199.1 units. For it takes 199.1 units of heat energy to raise one pound of water from 32° F. to 231° F. or on the absolute scale from 491.6° F. to 690.6° F.

By analysis in higher mathematics it is found that entropy of water may be quite closely computed by the formula

$$\theta = \log_e \frac{T_2}{T_1} \qquad (4)$$

Wherein θ is the entropy of water, T_2 the absolute temperature at the end of the heat application and T_1, the absolute temperature at the beginning which is usually taken at the melting point of ice or 491.6° F. on the absolute scale. Thus in this instance

$$\theta = \log_e \frac{T_2}{T_1} = \log_e \left(\frac{231 + 459.6}{32 + 459.6}\right)$$

$$= 2.306 \log_{10} \frac{(690.6)}{(491.6)} = .3399.$$

The value in the steam tables were arrived at by a slightly more accurate process than this by taking into account the fact that the specific heat of water is not constant as heat is added.

The Entropy of Evaporation.—Since the temperature remains constant during the evaporation of water into dry saturated steam, it is evident that the entropy curve in this case would simply be a rectangle as shown in the illustration wherein one dimension is of length **T** and the area swept off is of **L** units. Hence, the entropy for heat of evaporation is evidently

$$\text{Entropy of evaporation} = \frac{L}{T} \qquad (5)$$

or in this instance,

$$\text{Entropy of evaporation} = \frac{958.1}{231 + 459.6}$$

$$= 1.3875$$

Total Entropy.—The sum of the entropy value for water and for heat of evaporation is called the total entropy of dry saturated steam. This is evidently arrived at numerically by adding together the two preceding columns. Thus, total entropy = entropy of water + entropy of evaporation .... (6)

$\therefore$ Total entropy = 0.3399 + 1.3875 = 1.7274.

Tables for Superheated Steam.—In later pages of the steam tables are to be found data relative to superheated steam. As a subsequent chapter will deal largely with superheated steam computations, we shall delay the consideration of superheated steam tables until the reader has been more thoroughly grounded in other fundamental computations of dry saturated steam.

OZONE FOR THE CHILDREN—V. OR ENGINEERING TWISTERS RETOLD

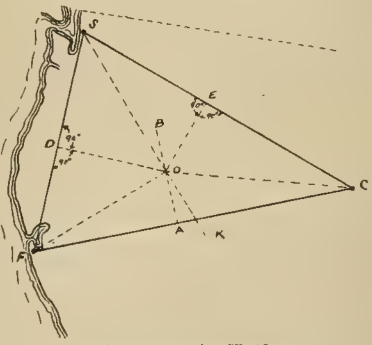
Emphasis on accuracy of diagramatic proportion can not be too strongly made. Here is a deduction that is absolutely geometrically correct, based on the diagram as shown.

Said he: "Did you ever realize that the distance from Seattle to San Francisco is the same as the distance from Seattle to Chicago?

Having knowledge of the fact that there was a difference in distance of several hundred miles, I quietly wondered what was coming now. So I said: "Can you prove it?"

Thus he proceeded:

Upon the map designated S C F let us bisect the angle at S, which is sketched as shown at S K. Upon F C erect a perpendicular bisector of F C as shown at



A Diagramatic Fallacy

A B. This line will intersect the line S K at some point O.

From O drop perpendiculars O D and O E. Draw lines O F and O C.

Now the triangle S O D = triangle S O E.

Since they are right angle triangles and angle O S D = O S E by construction and the line O S is common to both triangles.

Hence S D = S E, for they are homologous sides of equal triangles.

Also the triangle O D F = triangle O E C. Since they are also right angle triangles and since O D = E O (being homologous sides of equal triangles just proved above), and O F = O C, being lines connecting the extremities of the perpendicular bisector from point O on this bisector.

$\therefore$ D F = E C (being homologous sides of equal triangles.)

Adding we have

S D + D F = S E + E C
or SF = S C.

Hence the distance from Seattle to San Francisco must equal the distance from Seattle to Chicago.

SAFETY NETS FOR FALLING WORKMEN

The Safety Department of the Industrial Accident Commission has been responsible for the introduction of safety nets in San Francisco for buildings under the course of construction. These nets are used in some of the large Eastern cities and there are European countries that require a similar safety precaution. It is intended to secure the co-operation of California's building contractors in order that the safety nets may come into general use.

SPARKS—Current Facts, Figures and Fancy

(Electro-chemistry continues to arouse interest of engineers in the West. Vast preparation is being made in certain of the universities of this section of the country to properly undertake research work that may forward immeasurably the electro-chemical possibilites of the undeveloped resources of this section. Among the "sparks" given below may be gleaned further facts regarding this activity in addition to other facts, figures and fancy of interest to the engineer.—The Editor.)

Fuel briquets are on the increase in the United States. Over a quarter of a million tons were produced in 1916 having a value of a million and one-half dollars which represent an increase in valuation of forty per cent over 1915.

* * *

According to the Financial World of New York there are today provinces in Mexico where the people are free from war to carry on their industries and among themselves, though cut off from the rest of the world, they appear to be thriving.

* * *

A piece of Douglas fir, sixteen feet long and sixteen by eight inches in cross section, stood a pressure of eighty-eight thousand four hundred pounds before breaking, at the test conducted in the engineering laboratory of the University of Washington.

* * *

January established a new record for number of ships passing through the Panama Canal. In all there were seven hundred thirty-two, a net increase of ninety-two over the best preceding month. The aggregate net tonnage exceeded five hundred and fifty thousand tons.

* * *

That the famous "Japan Current," long credited with affecting the climate of California, apparently does not reach California at all and has no effect whatever on its climate, is one conclusion resulting from Mr. McEwen's studies of the currents and sea conditions off the coast of California.

* * *

How greatly sea-water may vary in temperature within a short distance is shown by the fact that with water at the harbor-mouth of San Diego Bay at a temperature of 66 degrees F., the shallow waters in the bay off National City registered 80 degrees F. A curious fact is that a difference of several degrees has frequently been observed in the temperature of the water in samples taken not sixty feet apart near the Coronado Islands, for instance.

* * *

These submarine depths are very different from surface waters. Two hundred feet down below the ocean surface there is scarcely one per cent as much light as there is three feet below the surface. Thirteen or fourteen hundred feet below the surface the temperature, summer or winter, is about 44 degrees F. and stays about the same the year round, while on the surface, a few miles west of the Coronado Islands, for instance, the water varies in mean monthly temperature from a minimum of 57 up to 68 degrees F.

From three thousand nail-pulling tests conducted by the Forest Service, it appears that the holding power of nails has a definite relationship to the density of the wood, and that there is practically no difference in strength between a solid beam and a wooden beam of the same dimensions made of two planks nailed together.

* * *

Only ten per cent of the average man's income goes for transportation—but transportation is regulated in the public's interest. Forty per cent of the average man's income is spent for food but the state takes no adequate steps to see to it that the amount of food is sufficient or that it is supplied upon terms fair alike to the consumer and the producer. It seems as if utility regulation may be vastly extended in the near future.

* * *

Each day brings more forcefully to mind the necessity of urging consumers to be more careful in the use of electric apparatus. Recently an electric pressing iron upon which a certificate of approval had not been issued, was left in service on the premises at the close of the day and the resulting fire caused a loss of thirteen hundred dollars. Another similar instance of recent record cost a medical institution thirty-five thousand dollars.

* * *

Laboratories for technical and electro-chemistry are especially important features of the new quarter of a million dollar chemistry building at the University of California, in recognition of the fact that one of the greatest of the opportunities which awaits California is the development of the chemical industries. With California's enormous supply of moutain water power and of cheap fuel, with vast stores of raw materials of infinite variety, and with the ocean at hand for export, there are illimitable possibilities in the development of chemical manufactures.

* * *

The Forest Service in co-operation with an American manufacturer of dyes in further establishing the use of osage orange was vigorously pushed during the year. This wood is now being commercially used for the manufacture of dyes, the total annual production being worth three-quarters of a million dollars. Carloads of osage orange wood are now being shipped from Oklahoma to eastern extract plants. Men in California and other Western commonwealths interested in getting into this industry should take the matter up with the Forest Service at Madison, Wisconsin.

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The Engineer and War Profits

One of the striking features of the present war situation is the pervading spirit among engineers and technical men generally to be of assistance to the country should occasion require and to give this assistance devoid of monetary consideration that could in any measurable way represent the value of the service rendered.

One instance of this kind may be noted in the case of Thomas A. Edison, the famous inventor who now serves as chairman of the Naval Consulting Board. Another instance is that of A. M. Hunt, so long connected with this Journal and its activities and for so many years a well-known engineering figure in the West, who is also with Mr. Edison.

Daily observation is bringing to light countless other instances throughout the West where engineers are either now actually engaged in loyal patriotic service or else are standing close to the shore ready to answer the call at any moment.

The growth of sentiment against war profits among public spirited engineering manufacturing concerns is also to be noted with entire satisfaction by citizens generally. The doctrine that all profits should be taken out of war if hostilities become inevitable, and the assertion of the doctrine of state above individual rights find strong endorsement in every quarter of the West.

The task ahead calls for whole-hearted patriotism from all interests, and after serious quiet consideration should the call be heard, the engineer of the West will stand ready to meet with un-selfed service every emergency that may arise.

The Human Side of Efficiency

Much has been said of late relative to time study and the most efficient way of performing a given task. In practically all of these investigations an attempt has been made to fit the man to the job in the most efficient manner possible. Would it not prove far wiser to reverse this study procedure an endeavor to fit the job to the man? In other words, speaking from the broadest view point possible, would it not in the long run prove far more efficient to devote exhaustive investigation into the characteristics of the man and then endeavor to fit the job to these characteristics, rather than attempt to take the inanimate job and straddle the man to it?

Such investigators as Minor Chipman who recently gave an address before the San Francisco Engineers' Club on Efficiency, show conclusively by their reasoning that the human element does enter and furthermore that efficiency study, devoid of consideration of the human element in the workman, must in the long run prove to be a failure.

This leads us to the conclusion that the one hundred per cent efficient man is not the one who gives out quantitatively in labor upon a given job the same amount of effort as is put into the job similar to our mechanical method of rating machines, but rather is that man one hundred per cent efficient who works harmoniously and perfectly upon the job to which he is best suited, independent of the comparative accomplishment of other workers.

At first sight such reasoning seems too much in accord with Kipling's ideal longing to be a reality in which he says—

"But each for the joy of the working
And each in his separate star
Shall paint the thing as he sees it
For the God of the things as they are."

At the same time we all must admit in our own individual experience that the work which has actually been disposed of with least fatigue, was the work in which we were absolutely at peace—working for the "joy of the working."

It would seem, then, that ultimately, efficiency study will itself prove most efficient when the study of the inanimate job gives way to the study of the human mechanism and its ability to functionate in peace and contentment under a task best suited to the individual.

The Electrical Utilization Orders

The effective work that is being done throughout the West in an effort to reduce accidents is highly commendable. In California this work has proved unusually effective due to the close co-operation that exists between the State Industrial Accident Commission, the employer and the workman.

One strong factor that is to be mentioned in any analysis as to why accident prevention has proved so effectual in California is to be found in the manner in which the commission goes about its task of drawing up rules and regulations. Before any important regulations are posted they are first gone over and aired thoroughly by deputations representing the employers and the workmen involved. When thus harmoniously launched upon a common task of bringing about a means for promoting the common good in the most effectual manner the victory is half won even though the actual written drawing up of rules were lacking.

The latest rules of interest to electrical men put forth by this commission have just appeared under the heading of California Electrical Utilization orders. In general these orders appear to receive the commendation of electrical men. Especially is this true for the order covering the grounding. At best orders of this nature are difficult to specify so as to prevent a misunderstanding. For this reason members of the electrical industry should proceed with great patience until sufficient reflection and tryout of these orders can be had to demonstrate just wherein the orders may be defective, if defective at all.

Excellent Status of Electric Manufacturers

The general financial status of the electrical industry has been at no time in its history in such remarkably sound condition as it is today. From the earnings of central station companies on up through contractor, dealer, jobber to manufacturer the report comes back that sane management and careful reckoning are putting all lines of the industry on such a firm standing that permanency in stability is bound to result.

That many of the electric manufacturers have ceased to take munition contracts, holding their reserve in trained men and equipment solely for the use of the nation in case of war emergency, is another gratifying incident of recent trend in events electrical.

Take for instance the February financial statement of a prominent electrical manufacturer. The statement shows an increase in surplus of about 7 per cent, bringing the total surplus to more than $850,000. The net earnings broke the record for February, a short month, being greater than in any February since the founding of the company twenty-eight years ago. It is further stated that the bookings continue good and this represents straight electrical business, as the company, after completing several highly profitable munition contracts, has returned to the exclusive manufacture of electrical equipment. However, it has been announced that the company stands ready to re-enter the munition business if called upon by the United States Government, as it has, in addition to the equipment, the trained men necessary for the work. The common stock of the company continues on a permanent 8 per cent per annum basis, with the preferred yielding 7 per cent.

Such reports as these are indeed gratifying and lead men of the industry to come to a fuller realization of what the industry means to the country at large in the event of war and to continued peace and prosperity as the years of national growths unfold.

Exaggeration vs. Modesty in Expression

As someone has recently said "most of us are simple folk and we prefer to listen to language we can understand."

In no profession does such a statement apply with more force than in the electrical industry, where there are so many things that display inherently such wonders of truth that super-excellences of expression are uncalled for.

This state of affairs is not only to be observed in the oral expression of the engineer but indeed in every line of activity reached by the intricacies of his profession. The recent creation of the Wise power plant of the Pacific Gas & Electric Company ably illustrates this point. Upon entrance to this power plant the extreme simplicity of expression almost overcomes one when an endeavor is made to gather the fact in mind that herein is displayed before the vision the workings for the largest single discharge turbine unit thus far created in the art of engineering. When the switch was thrown to connect in the unit one would have been unadvised of this triumphant feat in engineering were he not a close observer of the operating movement at the switchboard.

Applying this same principle of design to expression in all phases of activity in the electrical industry —engineering, salesmanship, executive control— modesty and a firm respect for the precise truth are qualities that are certain to command respect—partly through their inherent charm and partly through the infrequency of their use. In a branch of the art such as the electrical industry precision of expression is of utmost importance.

PERSONALS

M. R. Buchanan of Silver City, New Mexico, has recently been elected president of the New Mexico Electrical Association for 1917-18. Mr. Buchanan's rise in the electrical industry has been rapid. In 1910 he accepted the position of superintendent of the New Mexico Light, Heat & Power Company of Silver City, which was taken over in 1912 by the Silver City Power Company. At that time he was given the position of manager, and has continued to fill this position to the present time in a most efficient manner. The prospects for the New Mexico Electrical Association are exceedingly bright for the coming season and members throughout that state are already looking forward to the 1918 gathering.

T. G. Whaling, assistant general manager and sales manager of the Westinghouse Lamp Company, is a recent San Francisco visitor.

C. G. A. Baker, vice-president and secretary of the Baker-Joslyn Company of San Francisco, recently returned from a short trip to Los Angeles.

B. J. Klein, Pacific Coast manager of the Bristol company recently returned from an extended business trip throughout the Northwest.

F. W. Milligan, president and ceramic engineer for the General Porcelain Company, of Parkersburg, West Virginia, is visiting the Pacific Coast.

F. H. Rieber, chief engineer of the Rieber Laboratories, has returned to his home office in San Francisco after an extensive trip throughout the East.

Romaine W. Myers, an electricial and illuminating engineer of Oakland, has been retained as consulting electrical engineer for the Judson Iron Works.

J. N. LeConte, professor of engineering mechanics, is recovering from an operation of appendicitis undergone recently at the Alta Bates Hospital in Berkeley.

Neil Hurley, president of the Hurley Machine Company of Chicago, and his nephew, have spent several weeks in California and left San Francisco for Chicago, Wednesday, March 20.

Henry F. Holland has severed his connection as manager of the electric range department of the Great Western Power Company at San Francisco and will be at Los Angeles until further notice.

Geo. A. Campbell, manager Truckee River General Electric Company at Reno, Nevada, has been elected president of the Reno Commercial Club, whose one thousand members practically constitute a state organization.

Willis M. Deming, of Schenectady, N. Y., has resigned his position with the General Electric Company and will spend some time on the Pacific Coast in rest and recreation, for which he has long felt the need.

Hal Lauritzen, of the Pacific States Electric Company, recently returned from a business trip throughout the East where he visited the factories of the Ivanhoe Regent Glass Works of the General Electric Company.

H. R. Noack, of the Pacific States Electric Company of San Francisco, recently returned from an extended trip throughout the east, where he visited the factory and offices of the Hubbard Company and Pierce Specialties at Pittsburg, Pa.

H. F Hartzel of the San Francisco office of Baker-Joslyn Company, has recently been transferred to Los Angeles as the Los Angeles manager of that company.

J. C. Martin, of the engineering staff of the Pacific Light & Power Company at Portland, has been promoted to the position of chief engineer. **W. N. Voegtly** has been appointed purchasing agent of the company to succeed C. H. Still, resigned.

T. E. Burger has been transferred from the position of manager of the Western Electric Company, Los Angeles, to the position of assistant manager of the company at San Francisco, the Los Angeles position has been filled by transferring **D. J. Butts** from Salt Lake City.

J. H. Montague, representative of the Chance Manufacturing Company of Centralia, Mo., manufacturers of the "Never Creep" Anchors, is a recent visitor at San Francisco, making tests and demonstrations of his anchors before the Bell Telephone Company and others.

F. O. Broili has resigned as industrial power engineer of the Northwestern Electric Company of Portland, Oregon, to become president and engineer for the Nevada Machinery & Electrical Company at Reno, Nevada, and also to do some special engineering work for the State of Nevada.

T. L. Stannard, a consulting engineer of the Northwest, formerly engaged in constructing the second unit of the municipal plant in Seattle, has been appointed by the city council of Portland to investigate the proposed municipal light plant proposition now under consideration by that body.

J. William Peterson, vice-president and general manager of the Richardson-Phenix Company of Milwaukee, is an interested Pacific Coast visitor. During his sojourn in San Francisco, Mr. Peterson gave an address on "Lubrication" which was listened to by an attentive audience at the Merchants' Exchange Building.

F. G. Baum has left for Lead, S. D., where he is installing a 4000 kw. hydroelectric plant for the Homestake Mining Company, the largest gold producer in the United States. **A. L. Wilcox**, who has been in Peru the past five years on the hydroelectric work for the Cerro de Pasco Mining Company, will have charge of the Homestake work and **A. M. Torpen** of **F. G. Baum's** office, has been placed in charge of the second hydroelectric plant in Peru.

George H. Duffield, after seven years of continuous service as secretary of the National Electrical Contractors' Association of the United States and business manager and editor of the association's official journal, The National Electrical Contractor, resigned February 1st to take effect April 1st Mr. Duffield has accepted a position with the McGraw-Hill Publishing Company, Inc., New York, as business manager of "Electrical Merchandising," and will also serve in an editorial capacity.

J. G. Scrugham, professor of mechanical engineering and dean of the engineering college at the University of Nevada since 1903, has been appointed State Engineer of Nevada. Mr. Scrugham carries to his new position a wealth of experience, having formerly been a consulting engineer for the Oregon Short Line, an assistant engineer for the Southern Pacific Company and consulting engineer and director for Elko-Lamoille Power Company at Elko, Nevada. He is first vice-president of the engineering division of the Associated Land Grant Colleges and served as chairman of the jury for mechanical awards at the Panama-Pacific International Exposition.

MEETING NOTICES FOR ELECTRICAL MEN

(The subject of war and its effect upon the life and activity of the engineer has largely engaged the attention of meetings of the electrical industry in the West during the past two-week period. Preparations for the Pacific Coast Convention of N. E. L. A. at Riverside, Cal., and of the Northwest Electric Light & Power Association convention at Spokane, Wash., have also been reflected in activities of the various electrical development gatherings throughout the West. In this issue the Journal presents its second "Builder of the West" in the personage of John A. Britton, the much beloved and respected vice-president and general manager of the Pacific Gas & Electric Company.—The Editor.)

San Francisco Section of A. I. E. E.

The San Francisco Section of A. I. E. E. met in regular monthly session at the Engineer's Club on Friday evening, March 23, 1917. J. A. Vandegrift of the National Lamp Works of the General Electric Company in Oakland, gave a paper on "Interesting Features in Connection with the Manufacture of Incandescent Lamps." The lecture was well illustrated with slides and the fifty men present enjoyed a profitable evening.

The San Francisco Electrical Development and Jovian League

Robert Sibley, editor of the Journal of Electricity, addressed the meeting of the San Francisco Electrical Development & Jovian League at the Palace Hotel on March 14, 1917. The speaker described in an interesting and entertaining manner recent experiences and observations in a tour of the Orient. Especial effort was made by the speaker to pave the way for a detailed presentation of possible future commercial and engineering activity in the Orient, which is to be the subject of an address by Julean Arnold, American Commercial Attache to China, who is to address the meeting on April 4. Percy Pitts, of the Pacific Gas & Electric Company, acted as chairman of the day.

The officers for the coming term were elected as follows: President, R. M. Alvord; vice-president, R. F. Behan; and members of the executive committee, Percy Pitts and E. E. Brown.

Chas. H. Victor, manager of Yawman & Erbe Co., was speaker for the meeting of Wednesday, March 21. Mr. Victor, who was introduced by W. S. Coleman of the Pacific Gas & Electric Company, spoke entertainingly and helpfully on the subject of proper kind of recreation for salesmen.

BUILDERS OF THE WEST—II

JOHN A BRITTON

That a man should prove, under fire, to have unusual executive ability in building the world's greatest hydroelectric distribution system—a system now heralded far and wide for its triumph in physical attainment and unrivalled esprit de corps in organization of its personnel—is indeed a distinction few live to attain. But, when through it all is manifested a kindly, buoyant desire to help one's fellow man, then indeed shows forth the spirit to be observed in those who should be classed among the true builders of the West. To John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, this issue of the Journal is affectionately dedicated.

The Engineer's Club of San Francisco

The members of the San Francisco Engineer's Club listened to a most interesting lecture by John R. Brownell, superintendent of safety for the California Industrial Accident Commission on Thursday noon, March 15, at the club rooms in the Mechanics' Institute Building. The speaker described the work of the commission in promoting safety study and the prevention of accidents in California.

Los Angeles Jovian Electric League

The American Red Cross was featured at the luncheon on Wednesday, March 21st, and the earnest and faithful workers of the Los Angeles Chapter took the league by storm and succeeded in enrolling not only every member but the league itself as a member of the Red Cross. R. H. Ballard, secretary and assistant general manager of the Southern California Edison Company, was chairman of the day, and made a few interesting introductory remarks in keeping with the spirit of the occasion, after which he introduced the speaker of the day, Mrs. Martha Nelson McCan, whose topic was "The Purpose of the American Red Cross." Making the startling statement that the United States has the smallest Red Cross membership of any of the larger nations, she appealed to the sympathy, patriotism and Americanism of her hearers, urging their support and assistance. Miss Gladis Cosgrove, instructor with the first aid classes now being established throughout the city, also spoke, explaining this phase of the work.

By-Weekly Luncheon of Portland Sections of N. E. L. A. and A. I. E. E. with the Oregon Society of Engineers

The bi-weekly luncheon of Joint Sections of the A. I. E. E. and N. E. L. A. with the Oregon Society of Engineers was held under the auspices of the Oregon Society of Engineers. J. P. Newell, vice-president, was chairman.

The speaker of the day was E. H. Beals, district forecaster, U. S. Weather Bureau, Portland, Ore. His subject was "Weather Forecasting."

Portland Sections of A. I. E. E. and N. E. L. A.

A joint meeting of the local sections of the American Institute Electrical Engineers and National Electric Light Association was held in one of the assembly halls of the Multnomah Hotel Tuesday evening, March 6. L. T. Merwin of the Northwestern Electric Company, was chairman and the speaker of the evening was W. J. Davis, Jr., of the General Electric Company. The subject of the paper was "Electric Drive for Battleships and Gear Reduction." The application of the principal of the reduction of gears to cargo ships received special attention from the speaker. The use of the electric drive for battleships and cruisers also was considered. The effect of the electromagnetic clutch in the world of engineering was described. The lecture was illustrated with lantern slides and sketches. About 300 engineers attended.

Oregon Society of Engineers

The regular monthly meeting of the Oregon Society of Engineers was held at the power plant of the Northwest Electric Company's plant in the Pittock Block, Portland, Oregon, Friday, March 16, 1917, at 8 p. m.

L. P. Merwin and his assistants, showed about 60 members of the Society through the steam electric and steam heating plant of the Company.

The Pacific Coast Gas Association Convention

The Pacific Coast Gas Association will hold its 25th annual convention at Santa Cruz, California, September 18 to 21, 1917.

The first exhibition of gas appliances held in connection with the convention at Long Beach, California, in 1914, was so successful, and the appliance section of the association has become each year more important, so that a committee of appliance men was appointed by the association to arrange for an exhibit of gas appliances during the convention week at Santa Cruz. The committee having this in charge consists of the following members: B. S. Pedersen, (chairman), George M. Clark & Company; H. W. Jackson, James Graham Manufacturing Company; R. L. Cardiff, Coast Counties Gas & Electric Company; L. C. Braun, Eclipse Stove Company; R. J. Thompson, Welsbach Company; Paul E. Haugh, Trenkamp Stove & Manufacturing Company; T. Leary, H. Mueller Manufacturing Company.

The committee has made arrangements for the holding of an exhibit of gas appliances at Santa Cruz, which it is expected will be better and more comprehensive than any heretofore had on the Pacific Coast. The ground floor of the "Casino" will be available for the holding of this exhibition, giving ample room in one of the finest exhibition halls in the West with all the facilities for exhibiting goods that can possibly be had.

A. I. E. E. Nominations

At the meeting of the board of directors of the American Institute of Electrical Engineers held in Chicago on March 9, the report of the commttee of tellers in its canvass of the nominaitnon ballots for candidates for the institute offices falling vacant July 31, 1917 was presented. As required by the constitution of the Institute, the board then selected by ballot its list of "Directors' Nominees," with the following result:

For President: E. W. Rice, Jr., Schenectady, N. Y.

For Vice-Presidents: Frederick Bedell, Ithaca, N. Y.; John H. Finney, Washington, D. C.; A. S. McAllister, New York

For Managers: Walter A. Hall, West Lynn, Mass.; E. H. Martindale, Cleveland, Ohio; Wm. A. Del Mar, New York; Wilfred Sykes, Pittsburgh, Pa.

For Treasurer: George A. Hamilton, Elizabeth, N. J.

An Electrical Council of the Board of Fire Underwriters

An electrical council of the underwriters' laboratories has recently been established by the board of directors which will deal with standards and reports on electrical materials and devices for light, heat and power, superseding in this department the fire council to which such standards and reports have formerly been addressed.

Standing of the Electric Baseball Clubs

	Won	Lost	Pct.
General	2	0	1000
Ermsco	1	1	500
Western	1	1	500
States	0	2	000

The Electric Baseball League began the season's play on Saturday, March 10th, when the Pacific States Electric Company "champs" of last year, was handed a 13 to 8 defeat by the ERMSCO team. The game was a "slug fest" from start to finish, both teams finding the opposing pitchers easy.

Mr. Samuel H. Taylor, president of the Electric Railway & Mfrs. Supply Company, opened the season by pitching the first ball. He throws from the port side, and from his delivery one would believe that Mr. Taylor is a big league pitcher. It is such an unusual occurrence for a "league opener" to reach the plate that we take special pains to mention the fact that Mr. Taylor not only reached the plate—but—he actually reached the catcher. After performing this great feat—he walked from the box and the game was in progress.

O'Connell started in the box for the "States" while Finley "tossed 'em" for Railway. It was cold and windy, consequently a bad day for pitchers.

The ERMSCO nine batted first, and by the time the third out had been registered, three runs had crossed the plate. The "States" came back in their half with two, but when the Railway scored three more in the second and one each in the fourth and fifth it looked like an easy ERMSCO victory, with the score 8 to 2. But, in the fifth the States found Finley for 1 run. Two doubles, scored another in the sixth. They added three more in the seventh. With nobody out, Rylander replaced Finley the next three batters being strike-out victims.

ERMSCO went to bat in the eighth leading 8 to 7, but this lead didn't satisfy them, so they chased four more runs across the plate. One more in the ninth made the total count thirteen. The best the "STATES" could do was to gather one more in the eighth, making their total eight.

And so the battle royal has continued with the result to date as set forth in the above tabulated statement.

BOOK REVIEWS

Telephone Apparatus. By George D. Shepardson; size 6 in. by 9 in.; 337 pp.; 114 illustrations; cloth binding. Published by D. Appleton & Company of New York and London, and for sale at the Technical Book Shop. Price $2.00.

The author of this work is professor of electrical engineering at the University of Minnesota. The treatment of the text is made under four main headings—speech sounds, receivers, transmitters; signaling equipment; sources of electromotive force and protection; and appendices.

This volume deals principally with apparatus, giving only minor attention to circuits. The book presumes that the reader has a working knowlelge of algebra, trigonometry, calculus, and physics, including the laws govering direct and alternating currents. Appendices are given in the back of the volume for such readers who may be out of practice with the more extended mathematical developments of the text. The book is replete with references which should prove valuable for further research and study on the subject. The work should prove especially valuable for advanced students in telephony.

Electric Central Station Distribution Systems. By Harry B. Gear, A. B., M. E. and Paul F. Williams, E. E. Second edition, thoroughly revised and enlarged. Size 6 in. by 9 in.; 456 pp.; 187 illustrations; cloth binding. Published by D. Van Nostrand Company and for sale at the Technical Book Shop, San Francisco. Price $3.50.

The rapid changes in the conditions under which electricity is distributed and the progress made since the first appearance of this treatise have necessitated numerous changes and additions of considerable new matter. The subject of urban transmission and high-tension distribution has been made the subject of a separate chapter. The discussion of overhead and underground construction has been made to include recent progress. The diversity factor has been broadened and supplemented in discussion. Other chapters are devoted to separate considerations of substations, voltage regulation, line transformers, secondary distribution, protective apparatus, cable work and distribution economics.

The mechanical features of the text and illustrations are clear and well executed. The matter as treated is of high order and should engage the attention of all interested in the subject under consideration.

COMMISSION NOTES

Notes of Utilities Commission of Idaho

In the matter of the application of the Washington Water Power Company, a corporation, for relief from certain requirements of General Order No. 10, the petition is granted.

In the matter of the application of W. W. Roberts and C. T. Inskip, partners, doing business under the firm name and style of Roberts-Inskip Plumbing & Heating Company, for a certificate of public convenience and necessity, the commission denied the request.

Notes of Utah Utility Commission

The Utah legislature has enacted a public utilities law and it has been approved by Governor Bamberger. A public utilities commission is created and they have been given jurisdiction over the steam and electric railways, all common carriers, express companies, lighting, power and gas companies, heating companies, telephone and telegraph companies, water corporations including irrigation companies, and warehousemen. A salary of $4000 is provided for each of the three commissioners. A strong attempt was made by some of the members of the legislature to have included within the jurisdiction of the commission coal companies, sugar companies, lumber companies and other lines of trade which may be found by the commission to have a virtual monopoly of the business in the state but this provision was finally defeated.

Notes of California Water Commission

George H. Ayers of Fort Bidwell has applied to the State Water Commission for permission to appropriate 575 cubic feet per second of the waters of Cowhead Lake and 125 cubic feet per second of the waters of Twelve Mile Creek, both tributary to Twenty Mile Creek in Oregon, the diversion being in Modoc County. The proposed diversion and storage dam dimensions are given as follows: Height of dam, 45 ft.; width at top 650 ft.; width at bottom, 135 ft. The type of construction is given as rock fill. A main canal 44 miles long is part of the proposed works. The reservoir created by the proposed dam is intended to hold 115,000 acre feet of water. The estimated cost is given $450,000 and the acreage to be watered as 40,000.

Benj. J. Bennett of Salt Lake City has applied to the State Water Commission for permission to appropriate 20,000 acre feet per annum of the waters of Baxter Creek in Lassen County for irrigation. The proposed works consist of a dam 65 ft. high, 1560 ft. at top and 590 at bottom of steel piling cut off, earth fill and rip rap face. The estimated cost of the project is given as $300,000 and the area to be watered as 10,000 acres.

W. P. Boone of Berkeley has applied to the State Water Commission for permission to appropriate 20,000 cubic feet per second of the waters of Kings River in Fresno County for the purpose of irrigating lands in Fresno, Tulare and Kings counties. It is proposed to organize a district to be known as the Kings River Conservation District. The application specifies a dam 300 to 315 ft. high, 1200 ft. long on the top and 215 ft. long at bottom of concrete construction, forming a reservoir with a storage capacity of 600,000 acre feet. The project proposes the irrigation of 1,200,000 acres and the estimated cost is given as $9,000,000.

Ed. Fletcher of San Diego has applied for twenty cubic feet per second of the waters of Santa Maria Creek, tributary to Santa Ysabel River for irrigation purposes. The diversion dam, which is also to be the reservoir dam, is as proposed, 60 ft. high, 600 ft. on top and 50 ft. on bottom of arched type with overflow over concrete face of dam. The proposed storage is 8000 acre feet. The works contemplate a pipe line and canal nine miles long. The estimated cost is given at $200,000 and the acreage to be irrigated as 1320.

The East Side Land & Water Company of Los Angeles, has applied for permission to appropriate 500 cubic feet from Cowhead or Pelican Lake and 125 cubic feet from 12-Mile Creek in Modoc County for irrigation purposes. The name of the proposed works is the Surprise Valley ditch. A main canal from the creek is to be, as proposed, three miles long and a canal from the lake to be 41 miles in length. The diversion dam on 12-Mile Creek is given in the application as 60 ft. long on top and 40 ft. on bottom, rock-filled and timber cribs. The diversion at the lake is also the storage dam. The construction is rock fill with inner core with back slope of rip-rap and front slope earth fill with rip-rap front face, to be perfected by a 10 ft. toe-wall of rubble masonry, a spillway of 30 ft. width on each side of dam. The proposed structure is to be 43 ft. high, 350 ft. long on top and 132 ft. on bottom, front face 3 to 1 slope and back face 1½ to 1 slope. The estimated cost is given as $800,000 and the number of acres to be irrigated as 25,185.

Frank K. Mott of Oakland has applied for 100,000 acre feet per annum of the waters of Ash Creek, tributary to Pit River in Modoc County, the works to be known as the Round Valley reservoir. There is a proposed storage dam 100 ft. high, 1000 ft. long on top, and 200 ft. on the bottom and 20 ft. wide on top with a height over water when full of 20 ft. The construction is of earth fill type with concrete cut-off wall.

W. B. Baker of Los Angeles and F. H. Merrill of South Pasadena have filed three applications with the commission for permission to appropriate water from several different sources for use in the Coachella Valley, in the vicinity of Indio, Coachella, Mecca and Thermal. The first application proposes to appropriate waters from Whitewater River, Mission Creek, Dry Morongo Creek, and Big and Little Morongo Creek, in San Bernardino and Riverside counties, and carry them into Morongo Valley. By means of dams erected across the various drainages and openings of Morongo Valley it is proposed to impound and store the said waters involving a watershed of about 170 square miles. The application states that storage is afforded for 240,000 acre feet of water. The second application asks permission to appropriate all the unappropriated waters of Pipes Creek and Antelope Creek in San Bernardino County and divert same into Morongo Valley and store same, involving a watershed of 28 square miles. The third application seeks permission to appropriate the waters of streams and creeks flowing into Baldwin's Lake and the waters of the Lake itself, and the unappropriated waters of Arrastre Creek, diverting the waters of Arrastre Creek into the lake also and there impounding them, involving a watershed of 54 square miles. These waters are then to be carried into Morongo Valley and stored with the others, the whole to be finally conducted to the lands proposed to be irrigated in the Coachella Valley. Permission is also asked for the waters of Snow Creek in Riverside County, it being the plan to pick them up in a flume that carries the other waters to the valley. The commission has allowed applicants further time in which to submit maps and other data.

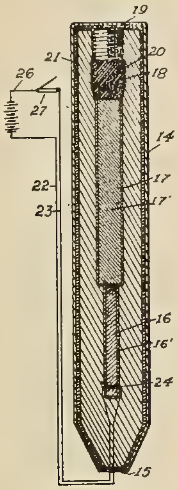
The City of Los Angeles has applied for 200 cubic feet per second of the waters of the South Fork of the Kern River in Tulare County for the purpose of generating electricity and power for that city. There is proposed a diversion dam 20 ft. high, 150 ft. long on top and 40 ft. on bottom of timber crib with metal gates in concrete settings. A conduit and pipe line five and one-half miles long will conduct the water to the power house, where under a 1500 foot head it is proposed to develop 18,000 theoretical horsepower. The cost of the project is given as a million and a half dollars and the application sets forth that it is one of the units of the plant to be assembled by the city of Los Angeles, which will comprise several others in Inyo and Mono counties.

WHAT WESTERN INVENTORS ARE DOING

(The effect of war shows its imprint in patents of the last two week period in the invention of devices calculated to destroy submarines. The impetus in mining, too, is reflected in the invention of an electric-blasting-cap protector. The electric circuit controller, insulator, electric oven and a new electrode for the generation of pure oxygen also come in for their share of attention, as noted in the following briefs of recent patents issued at Washington.—The Editor.)

1,218,504. **Electric-Blasting-Cap Protector.** Ford Alexander, Taft, Cal.

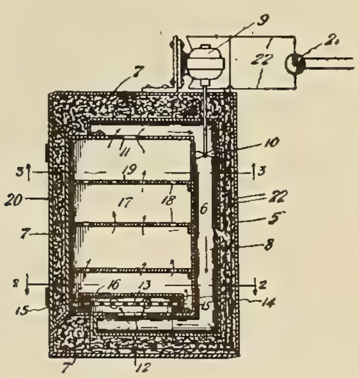
A detonating cap comprising a cylindrical body member of fragile material and having a pointed end, the member having a relatively small initial explosive chamber and a rela-



tively large explosive chamber connected therewith, the walls of the chambers being coated with a water-proof layer, a screw plug closing the large chamber, a water-proof layer inclosing the body member, a water-proof wrapping incasing the member, a second water-proof layer in the exterior of the wrapping, and electrically operated means for exploding the charge in the small chamber.

1,218,341. **Electric Oven.** Clarence Truitt, Pomona, Cal.

The combination with an electrically heated oven, of an air duct disposed between the walls thereof, and substantially surrounded by a non-heat conductor, the duct being contin-



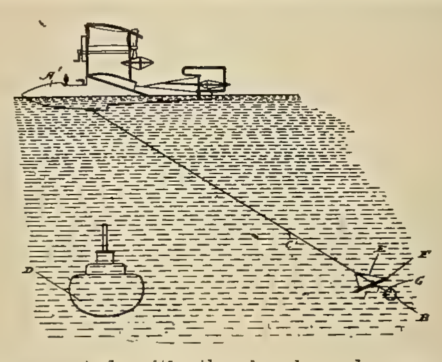
uous and communicating with the upper and lower portions of the oven, a heating elements disposed over an opening of the duct to retard the circulation and means to produce a cyclic change of air or other medium within the oven, through said duct, and force the air into contact with the element to reheat the air.

1,218,584. **Electrode for Generating Pure Oxygen.** John F. Sanders, Roseburg, Ore., assignor to Oliver P. Coshow, Roseburg, Ore.

A compound electrode consisting of a hydrogen absorbing substance and a catalyst adapted to render said electrode capable of giving up its hydrogen contained in solution.

1,218,586. **Destruction of Submarines.** Joseph A. Steinmetz, Philadelphia, Pa.

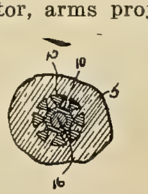
An apparatus comprising the combination with a flying boat of a bomb suspended at some distance below the boat by a suitable cable, and a forwardly and downwardly inclined



open tube connected with the bomb and arranged to be pressed downward by the action of the water when it is drawn rapidly through the water.

1,218,480. **Insulator.** John Sayer, Flagstaff, Arizona.

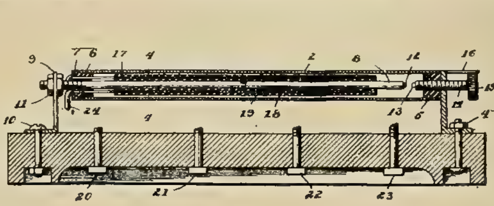
An insulator, a hollow metallic core extending throughout the length of the insulator, arms projecting outwardly from



the core and embedded in the body portion of the insulator, and a conductor extending through the core.

1,217,982. **Electric-Circuit Controller.** Will C. Neahr, Denver, Colo., assignor to The Protective Signal Manufacturing Company, Denver, Colo., a corporation of Delaware.

An apparatus of the character set forth, the combination



with a tubular member, of a rod member mounted longitudinally therein, coacting contact elements located in one end of the tubular member, one being carried by the rod, an electric heating coil mounted on the rod, and a sleeve of insulating material surrounding the rod and coil within the tubular members.

LATEST IN EVERYTHING ELECTRICAL

(The very latest in everything electrical for the past two-week interval is the unique and comprehensive telephone exhibit presented by the Pacific Telephone & Telegraph Company to the University of California Extension Bureau. A United States Supreme Court decision affecting power companies traversing national forests is also a happening of this period of immense importance to hydroelectric men generally. Apparatus of new features are also briefly described in the following pages, which should prove of timely interest to the engineer.—The Editor.)

A UNIQUE AND INSTRUCTIVE TELEPHONE EXHIBIT

BY C. H. JUDSON

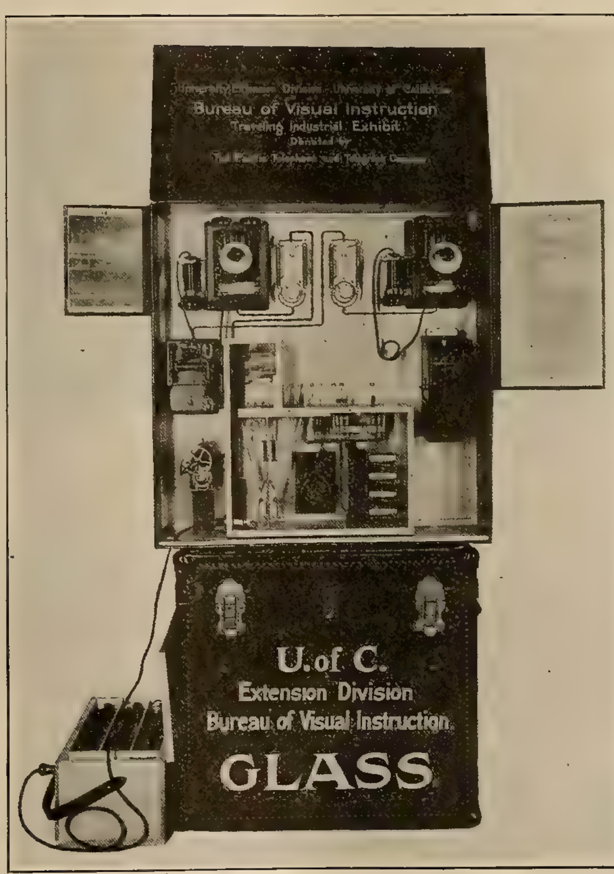
The Pacific Telephone & Telegraph Company has donated to the Bureau of Visual Instruction of the Universiy Extension Division, University of California, two rather remarkable exhibits. The exhibits are sent by the Bureau to the intermediate and high schools in the State of California in turn for the purpose of supplementing lectures and text books. One of the exhibits consists of a case with a glass front in which, mounted upon a velvet covered backboard, are the parts of the talking set, i.e., the transmitter and the receiver. The other exhibit, shown in the illustration, called the operating exhibit, consists of a central office switchboard section containing two line circuits and one cord circuit, together with coin collectingequipment. From the switchboard run subscriber lines to two telephone sets all contained in the case. Each of the subscriber stations is provided with a coin box and the usual protector equipment. One of the coin boxes is of the prepayment type, the other being the non-refunding box. In the telephone sets, the front boards are removed and glass plates substituted so that the operation of the interior mechanism is plainly visible. The coin boxes are similarly provided with glass fronts, and the course of the coins through the boxes may be traced. A case containing a battery of dry cells accompanies the exhibit which is thus rendered fully operative, and a connection from one telephone set to the other may be set up in the regulation manner. There is no glass front to this case so that the apparatus is entirely accessible for the purpose of demonstration.

The cases are provided with stout trunks for transporting. Tablets explaining the exhibits are attached to the cases, the text being printed on an enameled plate. The operating section has, attached to the left side, a hinged leaf upon which is mounted a photograph of a section of a standard central office switchboard. Circulars containing the descriptive matter are also supplied.

The exhibits are the product of much thought and painstaking effort on the part of the engineers of the Telephone Company who were given the task of preparing them.

The Bureau of Visual Instruction is doing a remarkable work in the schools of the State. It has already in use a very large number of exhibits illustrating the manufacturing industries of the country. In these the processes of manufacture are illustrated by photographs and samples of the products from the raw materials to the finished articles are shown. In the schools, the students are instructed to study the exhibits and to write the stories which they get from them. In addition to the drill in composition, the pupils gain a knowledge of the important industries which is of incalculable benefit and which in the great majority of cases has heretofore been inaccessible to them.

The Telephone Company's exhibits were shown at the Rotary Club and at a luncheon of the Home Industry League prior to being put on the school circuit. They have been on exhibition at the Lick School, Wilmerding School, Lux School, Polytechniic High School and Cogswell School in San Fran- Polytechnic High School and Cogswell School, Oakland. They will be at the Oakland High School, Oakland, from April 9 to April 23.



A Forceful Educational Exhibit

A FAR REACHING COURT DECISION

Regulations of the Agriculture and Interior Departments' conservation policy and decrees requiring the Utah power companies to remove their property from the public lands unless they procure Federal permits were sustained recently by a decision of the United States Supreme Court.

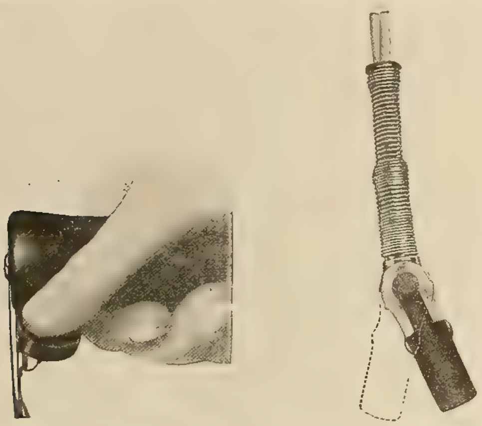
The court maintained the power of Congress to regulate all public lands and denied that its authority was limited to lands actually used for Federal purposes. All government regulations were not specifically upheld, but the court refused to disturb any of them. It also held the government to be entitled to reasonable compensation from the Utah power concerns for use of lands occupied.

Far-reaching questions affecting electric power development in Utah, Colorado, Idaho, Nebraska, Nevada, California, and other "public land" states, and incidentally presenting some of the most fundamental questions of states rights to come before the Supreme Court in many years, were involved in the government's suit to force the Utah Power & Light Company and the Beaver River Power Company from public lands in the Wasatch and Fillmore Forest Reservations in Utah.

Judgments directing both companies to remove their plants from the forest reserves, but refusing an accounting to the government, were entered on March 4, 1915, by the Utah Federal Court.

A NEW DEVICE TO PREVENT CORD BREAKAGE FOR ELECTRIC IRONS

Cord Breakage in electric irons has been a source of much worry to consumers, dealers, and manufacturers, and has really come to be considered as almost an incurable malady. Numerous remedies have been prescribed, tried, found ineffective, but as usual perseverance has triumphed. Word comes from the Development Department of the Hotpoint Electric Heating Company at Ontario, California, of a hinged cord protector switch plug which eliminates cord breakage and the many other ills to which previous style plugs were heir.



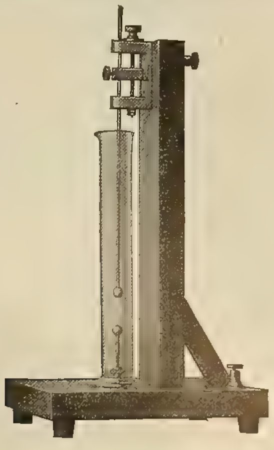
New Preventatives for Electric Iron Cord Breakage

Our correspondent advises the general construction of the plug and path of the cord as it leads into the plug to be as follows:

"The cord first passes through a smooth composition bushing at upper end of a spiral spring which prevents chafing at that point. It continues through the double spiral spring, the ends of which are securely fastened to the slide hinge joint at upper part of metal plug cap. The spiral spring supports the cord and prevents sharp bendings or kinks (most common near the plug) in the cord. The hinge joint still further relieves the cord and by adding flexibility, spring will not interfere with arms of operator. The composition plug bar forms an anchor for the cord, which is wrapped around it in a way to relieve all possible strain from the copper conductor and where it is fastened to the binding screws. The increased length of cord necessitated by the loop around the plug bar prevents heat reaching point at which actual bending occurs which further adds to life of conductor."

NEW OIL TESTING CUP

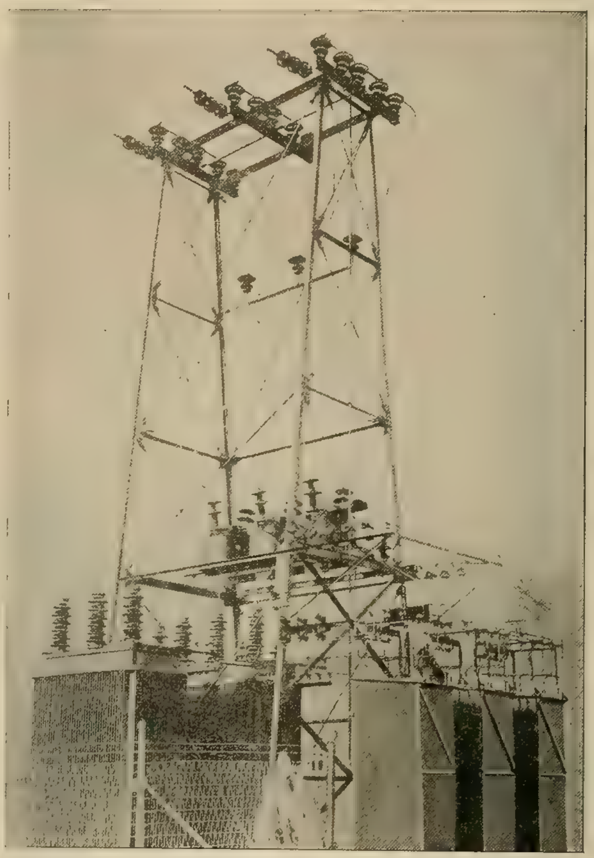
The oil testing cup shown, which consists of a graduated glass cylinder containing two testing terminals, each a brass sphere ½ inch in diameter, has been placed on the market by the Westinghouse Electric & Manufacturing Company of East Pittsburg, Pa., for convenience in making dielectric tests of insulating oil. The upper sphere is adjustable in its distance from the lower one by means of a micrometer screw with a milled thread.



New Oil Testing Cup

OUTDOOR SWITCH-HOUSES

The problem of properly housing and protecting switching equipments is one of considerable importance in installations which supply electrical power to small towns, manufacturing plants, mines, etc., where the load is not large enough to warrant the expense of a substation with indoor apparatus. For outdoor distributing substations of this character, portable switch-houses such as are shown in the accompanying illustrations, have been found to give such satisfactory service that the tendency is toward an increase in their application as well as in their size and capacity.



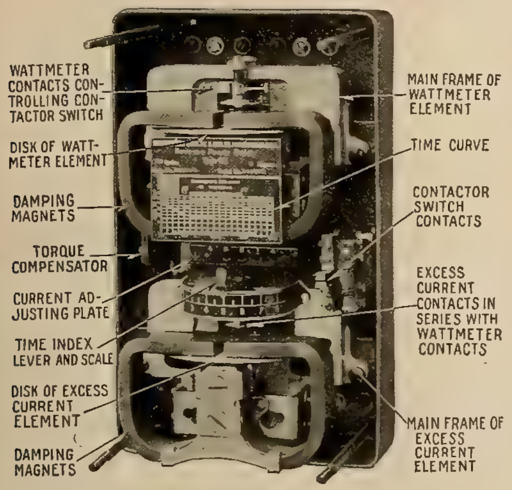
A Typical Outdoor Switch-house

EXHIBITS OF CLASS "D" MEMBERS IN CONNECTION WITH THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION MILLION DOLLAR PIER, ATLANTIC CITY, NEW JERSEY

The exhibition committee have issued their circular covering the exhibits to be held in connection with the convention of the National Electric Light Association on Million Dollar Pier, Atlantic City during the week of May 28th. The floor plan shows the location of exhibits, meeting rooms, registration bureau, committees and sections with all other details, including the exhibit of the Lamp Committee, lighting appliance section and electric vehicle section, also full details and cost of space. The exhibit committee announce that they have secured almost double the space used in former years, and are pleased to advise that they have been able to reduce the cost of space by less than half any previous exhibit.

THE INDUCTION RELAY

The first induction type of relay was placed on the market in 1902 by the Westinghouse Electric & Manufacturing Company. The induction principle of the operation was the same as had been used with great success in the company's alternating current integrating wattmeters (now watthour meters) for several years prior to this time. Even in its early design, this relay was superior in accuracy, reliability, and



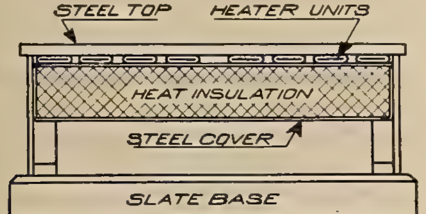
Detailed View of Induction Relay

sensitivity, to relays operating on other principles. One form was enclosed in a round case, while the other was of open construction designed for mounting on a panel board. The torque compensator was first placed on the market in 1913 by the same company, as a separate device to be used in connection with the induction relay.

Since its introduction, the development of the induction type of relay has advanced continuously. It has had various forms and has finally culminated in two types of relays, the torque compensator being included self-contained, as a part of the relay.

THE USE OF INDUSTRIAL ELECTRIC HEATERS

In the Bureau of Engraving and Printing, Washington, D. C., 600 C-H rectangular industrial stoves are in use for the heating of engraved plates from which bank notes are printed.



Heater Unit for Warming Engraved Plates

In the accompanying illustration some of these units (made by The Cutler-Hammer Manufacturing Company of Milwaukee) can be seen. These stoves are spring mounted in a cradle so that there is a pressure upward against the under side of the plate.

A NEW CORD CONNECTOR

The extensive use of the three-wire line, introduced by Harvey Hubbel, Inc., of Bridgeport, Conn., about three years ago, has made necessary the addition of a durable 10 ampere cord connector which could be used in linking up permanently installed wall or flush receptacles with portable machines, appliances and laboratory apparatus wired for three-wire work The composition cap of this connector is interchangeable with all of the three-wire attachment plug bases, wall receptacles and flush receptacles listed by the company.

NEW BULLETINS

The Underwriters Laboratories, Chicago, are now issuing a pamphlet entitled "Electrical Data," giving typical causes and losses from fires of electrical origin. Copies may be had upon application.

The Sprague Electric Works of the General Electric Company has recently issued bulletin 41514, descriptive of single-phase motors of varying speed type, also an interesting pamphlet on electric fans has just made its appearance to the trade.

The publicity department of H. M. Byllesby & Company, has just completed some very useful and attractive booklets for distribution to consumers. These books are designed to place in the hands of the customer, the general information referring to his service, and contain considerable educational matter concerning meters, basis of rates, definition of gas and electrical terms, etc.

"Westinghouse Electric Fans" is the title of Catalogue 8-A just issued by the Westinghouse Electric & Manufacturing Company. A series of leaflets on the electric range, controllers for steel mill and crane service has also made its appearance to the trade. "Manager Wise buys Westinghouse Small Motors" and "Westinghouse Railway Accessories" are also recent booklets by this company covering matter suggested in the title.

TRADE NOTES

The Garland-Affolter Engineering Company of San Francisco, dealers in Moloney transformers, Howell polyphase motors, Peerless single-phase motors, electrical controlling apparatus, high tension substation and pole line equipment has opened branch offices in the San Fernando Building, Los Angeles.

Wilbur J. Watson, William R. Davis and Harlan Miller, a group of engineers heretofore united for the purpose of designing a San Francisco-Oakland bridge, have made announcement of their organization as the Watson-Davis-Miller Company, for the purpose of conducting a general consulting, designing and inspecting engineering business with offices in Cleveland, O., Albany, N. Y., and San Francisco, California.

F. S. Viele, president of the Arizona Power Co., reports that the company has entered into a contract with the Consolidated Smelting Company for a three-year term with a minimum of 1000 h.p. It is expected that actually from 1200 to 1400 h.p. will be used. This is about double the amount used at present. The Arizona Power Company has also closed a contract with the Gadsden Company and has made new contracts with the Jerome Victor Extension and the Verde Combination. Work is going forward rapidly on the new Arizona steam generating plant.

A third hydroelectric unit has been purchased to be installed at the White River plant near Seattle, Wash. The turbine will be 23,000 h.p. capacity under 440 ft. net head and 360 r.p.m. The generator will have a rating of 20,000 k.v.a. Owing to the eminently satisfactory performance of the present two units which have been in service continuously for over five years, the contract has been awarded the hydraulic department of the Allis-Chalmers Manufacturing Company, including all accessories, such as governor, relief valve, and butterfly valve. The electrical equipment will again be furnished by the General Electric Company.

NEW ELECTRICAL DEVELOPMENTS

(The most significant new electrical development of the two-week period comes from Portland where it develops that the municipal electrical enterprise previously thought possible at a low cost of service is now said to be underestimated by such a considerable figure as to make its passage by the people at an election in June a case of considerable doubt. Other notations of happenings throughout the West are appended.—The Editor.)

FINANCIAL

SAN FRANCISCO, CAL.—The Northern California Power Company, consolidated, for 1916 shows an increase in net income over the previous year of $56,304, or 13.2 per cent. Net after interest was $128,738, a gain of $66,280 for the year. President W. F. Detert, in his report to stockholders, says interest paid during 1916 was $9075 less than the amount paid in 1915, and the amount of interest charged to capital on account of construction work in progress during the year, so that the amount of interest properly chargeable to the year's operations was $9976 less than for the preceding year. An inspection of the report shows that there has been a growth in all departments of the company's business—approximately 9.1 per cent in electric, 13.6 in gas and 2.1 in water revenues.

SAN FRANCISCO, CAL.—The Mt. Whitney Power & Electric Company has reported to Blyth, Wittier & Company earnings for the calendar year of 1916 as follows:

Gross revenue	$782,207.40
Operating expenses, maintenance and taxes	331,847.57
Uncollectable accounts	8,986.94
Net revenue	441,372.89
Bond interest	199,573.96
Balance	241,798.93

It is most interesting to note the effect upon this company's business of the reduction in its rates which was made by the Railroad Commission early in 1916, at a hearing held at the company's request. Revenues in each department have registered healthy increases, due to new business which has been taken on by reason of the lower rates.

SAN FRANCISCO, CAL.—Coast Counties Gas & Electric Company closed the calendar year 1916 with gross earnings of $363,979, net operating income of $167,740, and a cash surplus after all expenses, charges and depreciation allowances of $67,519. This surplus compares with $59,201 earned in 1915, and the other items of the account show a corresponding improvement. The income statement for the year and the balance sheet, as of December 31, 1916, follow. Income account for 1916:

Gross earnings	$363,979.66
Operating expenses, inc. taxes	196,239.27
Net operating income	167,740.39
Bond and debenture interest	76,536.96
Other interest	2,522.20
Amortization of debt, discount and expense	1,162.08
Depreciation	20,000.00
Surplus	67,519.15

The Coast Counties Gas & Electric reports earnings for the two months ended February 29, 1916, as follows:

Gross earnings: 1917, $57,122.13; 1916, $53,560.28, increase, $3561.85; expenses, maintenance, taxes, 1917, $29,067.19; 1916, $28,295.66; increase, $771.53; net income, 1917, $28,054.94; 1916, $25,264.62, increase, $2,790.32; bond interest, 1917, $11,055.50; 1919, $11,370.53; decrease, $315.03; other interest, 1917, $1898.81; 1916, $2111.32; decrease, $212.51; balance, 1917, $15,100.63; 1916, $11,782.77; increase, $3317.86.

INCORPORATIONS.

SACRAMENTO, CAL.—Articles of incorporation of the Red Rock Irrigation Company of Red Rock, Lassen County, with a capital of $20,000, were filed this week in the office of the Secretary of State. The object of the company is to supply water to residents of the district for both irrigation and domestic purposes. The capital stock is divided into 20,000 shares of the par value of $1 each. The directors and incorporators are: August Anderson, of Westwood and Ira C. Anderson of Red Rock, both of whom have subscribed five shares.

ILLUMINATION

COLUSA, CAL.—The board of supervisors has ordered the Northern California Power Company to install street lights on certain streets of the Williams lighting district.

PORTLAND, ORE.—The interstate bridge commission has awarded the contract for lighting the interstate bridge and its approaches to Nelson & Brown, contractors, for $4289.33.

LOS ANGELES, CAL.—The city council has ordered the installation of necessary appliances and furnishing of electric current for the lighting of Beacon street, between Fourth and Sixth streets.

LOS ANGELES, CAL.—An order has been made by the board of supervisors authorizing repairs and replacement of equipment in Bonita Meadows lighting district through the county mechanical department.

CLOVIS, N. M.—This city is seeking a loan to increase the capacity of its municipal light and water plant. A sum of $20,000, which is the least amount with which the enlargements can be made, must be obtained.

ATWATER, CAL.—An election will be held April 12 to equip and maintain a system of street lighting on public highways and to provide for the formation and operation of highway lighting districts in incorporated towns and villages.

FRESNO, CAL.—The board of supervisors has awarded the contract for establishing a lighting district at Caruthers to the San Joaquin Light & Power Corporation. The lighting system will consist of eight lights and the cost will be $1.85 per light per month. The contract is drawn for five years.

SALINAS, CAL.—The Coast Valleys Gas & Electric Company offers to lay a lighting system to the base of the poles without charge to the city and get its return from the lights. Expert Phillips recommends that the city own its own light system and small substation, which can be obtained at a total cost of $12,868.

LOS ANGELES, CAL.—Sealed bids will be received by the department of public service for 2000 suspension insulator units, each complete with malleable iron pin and cap, suitable for use seven in a series on 110,000 volt transmission lines, to be of best quality of brown glazed porcelain and approximately 10 in. in diameter.

FALLBROOK, CAL.—It has been voted to form the Fallbrook lighting district. Street lights will be installed by the San Diego Consolidated Gas & Electric Company. The district includes 30 blocks of the business and residential section. The present plans call for eight lights of 250 watts per light. It is expected that the district will soon be enlarged.

PORTLAND, ORE.—A city election will be held in Portland on June 4 to vote on an issue of $1,777,000 in 22-year 5 per cent serial bonds to be used in constructing the proposed municipal street lighting plant. The plan as outlined is to construct from water revenue a dam at Bull Run lake to increase the amount of water in the lake. From the $1,777,000 power plant bond issue an intake would be constructed to a flume 13½ miles above the Bull Run headworks

and a flume 13.2 miles long on the north side of the river to the reservoir would take care of the Bull Run headworks.

ESCONDIDO, CAL.—Arrangements have been completed for a transfer of the electric light and gas plant of the Escondido Utilities Company to the San Diego Consolidated Gas & Electric Company.

SAN MATEO, CAL.—The street lighting committee of the San Mateo Chamber of Commerce has formulated plans for the lighting of San Mateo's business district. It is proposed to improve the lighting on the following streets: B street from Fourth avenue to Baldwin avenue; Baldwin avenue to Ellsworth; Second avenue from the library to the Southern Pacific depot; Main street from Second avenue to Third avenue. This plan contemplates the installation of 47 single globe electroliers, each containing high power Mazda type "C" lamps.

PORTLAND, ORE.—The city council recently unanimously agreed to submit to the voters at the city election June 4 the measure proposed by City Commissioner Daly for a bond issue of $1,777,000 for the construction of a municipal lighting plant. The council in assuring Mr. Daly the measure would get a place on the ballot expressed the opinion that the bond involved should be raised in case figures to be compiled by J. L. Stannard show that the $1,777,000 would be insufficient. Hydroelectric engineers have estimated that Mr. Daly's figures are about $1,000,000 short of being sufficient to install the type of lighting plant he is proposing.

TRANSMISSION

INDEX, WASH.—This town has voted $10,000 in bonds for a municipal power plant.

LOS ANGELES, CAL.—The Pacific Light & Power Company will move its substation in South Pasadena to West Alhambra.

OROVILLE, CAL.—The Great Western Power Company is now beginning work upon the extension of its power lines along the north fork to the Engels mine in Plumas County.

BOISE, IDAHO.—Permission is given the Washington Water Power Company to construct a transmission line near Wallace in an order handed down by the public utilities commission.

ALAMEDA, CAL.—The Union Iron Works has been granted permission by the Alameda City Council to purchase electricity from an outside concern under the control of the council and board of electricity.

LOS ANGELES, CAL.—Application has been made by the Pacific Light & Power Corporation to Major Pillsbury, U. S. engineer, for permission to install and maintain three high-power electric wires across Newport Bay.

SAN FRANCISCO, CAL.—Bids are being received by the Board of Works for furnishing and delivering electric line transformers for the Lower Cherry River power development, contract No. 24, Hetch Hetchy Water Supply.

ROSEBURG, ORE.—At a meeting of the Roseburg School Board, J. C. English & Company of Portland, were awarded the contract to furnish and install the electrical fixtures and glassware in the new high school building for $750.

VALLEJO, CAL.—Bids will be received until April 2 for a franchise for which the Vallejo Electric Light & Power Company has applied, to construct towers, piers, poles, and suspend wires, cables, etc., for transmitting electricity.

GALLUP, N. M.—George A. Keepers has been granted the right to furnish electricity for power, heat and illuminating purposes to the citizens of Gallup, by constructing and maintaining for a period of 25 years an electric power plant for the manufacture of electricity.

SALEM, ORE.—The state may acquire a power site on North Mill Creek and make its own power for the capitol and state institutions, according to a discussion at the meeting of the board of control. The contracts for electric current will expire July 1, 1918.

AUSTIN, NEV.—The Kingston mine will be the scene of active mining operations this summer. I. M. Hirschfield, of San Francisco has about concluded the details of a lease and bond agreement. The first work will be the installation of a hydroelectric plant, using the old mill for the power building which will develop 600 kilowatt power.

RIVERSIDE, CAL.—Work is to start immediately putting electric light and telephone wires underground, which will permit of the removal of poles from Seventh street, between Orange and Lemon, and also on Lemon street between Sixth and Seventh streets. Poles will soon be removed from Eighth street from Market to Pepper.

FRESNO, CAL.—Construction work is progressing on the San Joaquin Light & Power Corporation's power house No. 2 in Madera County district, 40 miles east of Fresno, and the building and the new machinery to be installed represent an expenditure of approximately $400,000. The hydroelectric plant, when completed, will deliver 5000 horsepower of electric energy to the high tension wires of the power company.

GALLUP, N. M.—Geo. A. Keepers has presented an application to the town board for a franchise to operate an electric plant and to construct a pole and lines system for the purpose of conveying electricity for light and power to all parts of the city. Mr. Keepers states that if the franchise is granted the plant will be in operation before the first of June, 1917. In the neighborhood of $75,000 will be invested.

CHICO, CAL.—C. M. Burleson, a civil engineer of San Francisco, has submitted a plan for the formation of a public utilities district in Chico and vicinity. It is proposed to form a lighting district, construct the plant, ditches and other parts of the system, and maintain same for a period of 25 years, at the end of this time the district is to revert to the city, without cost. The profits from the plant previous to its becoming a municipal utility would go to persons erecting and maintaining it.

RENO, NEV.—An electric generating plant, developing 2500 horsepower will be constructed a short distance below Vista on the Truckee River as soon as weather permits, according to plans that have been perfected by the Nevada Valleys Power Company, which is now supplying current to Lovelock, Rochester, Fallon, Hazen and a number of mining camps. Preliminary work on its hydraulic system has already been commenced and it is expected to have the station in operation during the current year.

KLAMATH FALLS, ORE.—The California-Oregon Power Company will put on a force of 300 men just as soon as weather conditions will permit and rush to completion its big dam and power plant just across the state line at Copco, according to Manager G. Welton of this city. This new dam is being constructed across Wards Canyon, a rocky gorge of the Klamath River, 400 ft. wide. Water will be carried from the top of the dam to the power house in four steel pipes 12 ft. in diameter and will be capable of developing 50,000 h.p. The dam will crest a lake whose surface will be over 1000 acres.

MERCED, CAL.—Increasing use of electricity in farming is noted locally by numerous extensions of power lines and installations of pumping plant for farms of this vicinity reported by local manager Raleigh Casad of the San Joaquin Light & Power Corporation. The following have been announced: The construction of a power line from Atwater to Winter to serve the latter town; plans for the construction

of a power line to Irwin for irrigation plants; the construction of a power line to serve 7 pumping plants on the vineyard property of Ward B. Minturn in Yomato Colony; the installation of a line to the Robinson tract near Livingston for ten pumping plants for Arkalian Brothers. Many small extensions and plans are being approved for numerous others.

OROVILLE, CAL.—A plan for co-operation whereby the cities of Sacramento, Oroville, Chico, Gridley, Biggs, Marysville, Lincoln and Roseville would erect a power plant to supply those cities with electric power has been outlined. The cost of the project is estimated at $3,000,000.

SAN DIEGO, CAL.—Edward Fletcher of San Diego has applied to the State Water Commission for an appropriation from Santa Ysabel Creek in San Diego County for the development of hydroelectric power. A dam 110 ft. high and 800 ft. long is planned. The cost of the project is given as $350,000.

BREMERTON, WASH.—Specifications have been received at the navy yard for a power plant at the Keyport station. The plant will cost about $30,000. Bids have been called for. The power plant will be used for torpedo testing as well as for furnishing the light and power for other purposes about the station.

TRANSPORTATION

LOS ANGELES, CAL.—The Pacific Electric Railway Company will construct car inspection sheds at 800 Mission Road at a cost of $16,000.

ALPAUGH, CAL.—Bonds of the Alpaugh irrigation disfor the pipe and laying out about 600 acres of land for the extension of the irrigation system here.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been given a franchise for right-of-way on Eighth street, between Los Angeles street and Maple avenue.

GLOBE, ARIZ.—A temporary franchise has been granted by the city council to E. Sultan for an electric railroad on Broad street, a part of an interurban line that is planned to connect Globe and Miami.

SAN FRANCISCO, CAL.—Bids are being received by the board of public works for furnishing and delivering tie plates, rail braces, rail spikes, tie rods and auto creepers, being contract 91 Municipal Railway System.

TACOMA, WASH.—Immediate construction of the municipal street car line extension across the flats to the Lyleboe water way, occupied the attention of the council recently, following the passage of a bill at Olympia authorizing the work.

OAKLAND, CAL.—The San Francisco-Oakland Terminal Railways filed with L. W. Cummings, Oakland city clerk, application for a resettlement franchise to take the place of the many franchises granted under Oakland's former charter and which expire at different times.

MIAMI, ARIZ.—J. J. Mackay has filed a petition and request asking for permission and franchise to construct, maintain, extend, etc., under and upon public roads, streets, etc., in East Miami townsite and all additions thereto, water pipe lines, electric pole and wire lines, and other conduits for the transmission and distribution of water and electric current.

YUMA, ARIZ.—Application has been filed by the Yuma Light, Gas & Water Company for a franchise for the purpose of building an electric pole line from the city limits south along Orange avenue to the county road and thence westerly to the east bank of the East Main Canal for the purpose of supplying power for the operation of a pumping plant.

EL CENTRO, CAL.—A contract agreement has been filed whereby E. F. Sanguinetti of Yuma is to construct a 55,000-volt transmission line between the Holton power plant at Holtville and Hanlon Heading. In connection with the power line telegraph and telephone lines will be run across the sandhills to the Colorado River. The distance to be covered by the line is 43.5 miles.

TACOMA, WASH.—The Wheeler-Osgood Company soon will begin the construction of a new power plant on the tide lands at the cost of between $30,000 to $40,000. A permit for the construction of a stack 150 ft. high has been taken out. A battery of four boilers to furnish power for the dynamos will be installed and 1800 h.p. will be generated. The plant will be finished in 90 days.

QUINCY, CAL.—The State Water Commission has granted a permit to the Walker Mining Company of Salt Lake City to appropriate 20 cu. ft. per second of waters of Ward and Nye Creeks in Plumas County, for power purposes. The company's plans include building of a flume and pipe line 7692 ft. in length, and a power plant and transmission lines at a cost of approximately $25,000.

PORTLAND, ORE.—A petition of the Portland Railway, Light & Power Company to construct a broad gauge track on Yamhill street between First and Second streets, was denied by the council. The reason for refusing the grant is because the cars would interfere with the Carroll public market. The council expressed a willingness to grant the permit for a loop on Taylor street.

MODESTO, CAL.—The $465,000 bond issue of the Waterford Irrigation District has been validated at Sacramento. The bonds will now be signed by the president and secretary of the district, and by State Controller John S. Chamber and will be delivered promptly to the purchasers. The entire issue was sold by the district at bids of 97.1 several weeks ago, but validation was held up by the state pending further investigations by the state.

SAN FRANCISCO, CAL.—A project to irrigate 10,000 acres in Lassen County, with a total investment of $300,000, is disclosed in an application filed with the State Water Commission. The application is in the name of Benjamin J. Bennett of Salt Lake City and asks for the appropriation of 20,000 acre feet of water a year from Baxter Creek in Lassen County. The Sutter Basin Company of Sacramento also has filed an application for an appropriation of water to irrigate 8033 acres in that county. The company asks for 45 cubic feet per second from the Sacramento River. The work will cost approximately $20,000.

LOS ANGELES, CAL.—The board of supervisors has granted a franchise to the Pacific Electric Railroad Company to construct and for a period of 40 years to maintain an electric street railroad along certain public roads and highways of Los Angeles County, consisting of a standard gauge single and double track spur, over and across Covina boulevard, along Railroad avenue and over and along Clark street and Los Angeles street, single track spur over and across Covina boulevard and along Railroad avenue from the north right-of-way of the Pacific Electric Company, Covina line to Alderson avenue, double track spur over and across Clark street to the S. P. R. R. Company's right-of-way, single track spur over and across Los Angeles street.

TELEPHONE AND TELEGRAPH

SANTA ANA, CAL.—A building is soon to be erected by the Pacific Telphone Company on the corner of East Fifth and Bush streets.

BOWIE, ARIZ.—The Mountain States Telephone & Telegraph Company has purchased the entire interest of the local phone system and is modernizing the entire plant.

AUBURN, CAL.—People of the Gold Hill district are to improve their telephone service. It was decided at a meeting

that they will unite with the people of the Mount Pleasant District in building a new pole line from the Mulligan place to Lincoln.

ARCADIA, CAL.—Bids will be received by the trustees up to April 4th, for installing 29 reinforced concrete ornamental street lighting standards together with wires, pipes, conduits, globes, lamps and all necessary fixtures thereto on portion of First avenue.

GARFIELD, WASH.—At a meeting of the trustees of the Garfield and Rural Telephone Company, it was decided to accept the offer of W. M. Anderson to take over the system by the first of April and give connection with the long distance toll lines out of Garfield.

YUMA, ARIZ.—E. M. Burgess, vice-president and general manager of the Mountain States Telephone & Telegraph Company has been here looking over the ground relative to approving plans for an exchange at Sonerton, which would cover the entire two valleys and surrounding country. The plans contemplate an expenditure of $25,000.

SEWARD, ALASKA.—Linemen on snowshoes have just completed laying the telephone and telegraph line for the government railroad across a section of swamp in Susitna Valley, which is impassable in summer; and have opened communication from Seward to the Talkeetna River, 245 miles out, or over half way to Fairbanks. The northern end of the line is now located at camp "Dead Horse Hill."

IRRIGATION

SACRAMENTO, CAL.—The board of supervisors has approved plans for the formation of Fairoaks irrigation district.

PHOENIX, ARIZ.—Plans are now being drawn by the state board of control for an irrigation system for the capitol grounds.

SUSANVILLE, CAL.—At the election held here recently to determine whether Baxter Creek irrigation district should be formed, the result was in favor of the proposition.

SUSANVILLE, CAL.—Surveyors of the Honey Lake Mutual Water Users' Association have commenced surveys to determine the cost of bringing water from their project into Johnstonville district.

ARBUCKLE, CAL.—The chamber of commerce has instructed its secretary to correspond with Secretary Beard of the Sacramento Valley Development Association, Senator Purkitt and Assemblyman Polsey regarding needed irrigation of this section.

ROSEVILLE, CAL.—Western Placer County may have water for irrigation any time it is ready to receive it. Maps and plans of the entire distribution of water brought down from the hills by the Pacific Gas & Electric Company, have been completed.

FORT JONES, CAL.—At a meeting of property owners from the east side of the valley preliminary steps were taken for the formation of an irrigation district of approximately 6000 acres. It is designed to hold an election for the purpose in the near future.

HANFORD, CAL.—Gifford, Ascelano Olive Company has let the contract to the Adell-Cortright Concrete Pipe Company for the installation of 2½ miles of concrete pipe for irrigation purposes, which will cover the entire Gifford tract south of Huron.

SAN BERNARDINO, CAL.—The petition of the Mojave River irrigation district has been declared by the supervisors to be sufficient and the $2,500,000 water project of Victor Valley has been started.

OAKDALE, CAL.—Two storage propositions for the Oakdale and South San Joaquin irrigation districts were broached at a joint meeting of the two districts boards held here. The proposal of J. H. Cameron of San Francisco for building a dam capable of storing 80,000 acre feet of water was discussed at some length, but no action was taken.

HOLLISTER, CAL.—Despite the fact that this year's water supply is only half what it was a year ago at this time, Manager Paul F. Brown of the San Benito Land & Water Company, announces at this time the water was turned into the company ditches for the first time this year, that the supply will be ample providing no waste takes place.

SAN FRANCISCO, CAL.—Consulting Engineer Stephen E. Kieffer, Mechanics' Institute Building, states that plans will be completed and bids called for about the middle or last of April for approximately $280,000 worth of construction in Paradise irrigation district of Butte County. Included in this work is a hydraulic fill earth dam and about 30 miles of main pipe lines. Bids will be taken for both steel riveted and wood stave pipe in dimensions of from 3 in. to 36 in.

KLAMATH FALS, ORE.—The Keno irrigation canal has been leased by the government to the California-Oregon Power Company for a period of 10 years at a cost of $1000 a year. The contract was signed by Secretary of the Interior Franklin K. Lane and Alex J. Rosborough, vice-president of the power company. The contract provides that a dam may be erected by the power company within two years, if it so desires. Such a dam if constructed must furnish power for drainage and pumping requirements of the Klamath project at the rate of seven mills per kilowatt hour.

ELECTRICAL CLEARING HOUSE
OF THE WEST

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Buyers for Public Utilities

Will finance properties on a 5 per cent interest bond issue. The single plant owner or the syndicate operator can realize without publicity, as we have a large number of buyers whose combined capital is over one billion dollars. We submit each property to but one purchaser and make no promiscuous offerings. Box 199, Journal of Electricity, Crossley, Bldg., S. F.

FOR SALE

75 H.P. C-W.

1-75 h.p., 3-phase, 60-cycle, 440-volt, Crocker-Wheeler motor, in good condition. Box 701, Journal of Electricity.

50 H.P. C.-W.

1-50 h.p., 3-phase 60-cycle, 220 or 440 volts, 850 r.p.m., motor and starter complete, $460 f.o.b. S. F. Box 655 Journal of Electricity.

30 H.P. C-W.

3-30 h.p., 3-phase, 440-volt, 60-cycle, 675 r.p.m., Crocker-Wheeler motors and starters. Box 702, Journal of Electricity.

75 H.P. G. E.

1-75 h.p., 3-phase, 60-cycle, 220 or 440 volts, 850 r.p.m. Complete, absolutely guaranteed in first-class condition. Price $800 f.o.b. S. F. Box 651, Journal of Electricity.

7½ H.P. G. E.

1-7½ h.p., 60-cycle, 3-phase, 220-volt, 1200 r.p.m., General Electric motor, complete; for particulars address Box 563, Journal of Electricity.

10 H.P. Allis-Chalmers

1-10 h.p., 60-cycle, 3-phase, 1120 r.p.m., Allis-Chalmers motor, in good condition; complete; a bargain. Address Box 561, Journal of Electricity.

Transformers for Sale

3-Westinghouse transformers, 75 kw. type O.1.5.C., single-phase, 22000 volts primary to 2300 volts delta or 4000-volt star. Complete with oil. Never been used. 2-15 k.v.a., type H, G. E., 1200/2400—220/400; 1-1 k.v.a., type H, G. E., 1200/2400—120/240; 1-2 k.v.a., type H, G. E., 1100/2200—110/220; 2-2½ k.v.a. type H, G. E., 1100/2200—110/220; 3-125 k.v.a., type H, G. E., 2200/4400—220/440. These can be had at a bargain. Address Box 407, Journal of Electricity.

Transformer for Sale

We have on hand one Type W. C., 60-cycle, Form H, 133 kw., 22500 to 480 v. transformer. This transformer has been in use about six months only and is in first-class condition. Address Box 401, Journal of Electricity, Crossley Building, San Francisco.

Generator for Sale

1-100 kw. General Electric d.c., 110-volt generator; can be started up and seen in operation at any time; write for particulars. Address Box 207, Journal of Electricity, Crossley Building, San Francisco.

Eastern Manufacturers looking for a Western representative can be assured of the best results by talking to the men they need through the only electrical journal published west of Chicago.

FOR SALE

D. C. Generators For Sale

1 Fairbanks-Morse No. 2440-G, 25 kw., 240-volt, 104 amp., 1075 r.p.m.

1 General Electric, Type CVC 114, 12 d.w., 96 amp., 125-volt, 1800 r.p.m.

NEVADA VALLEYS POWER CO.,
Lovelock, Nev.

Western Engineers looking for a chance to better their positions should be listed on this page, where Western companies can find the men they need right here in the West.

MOTORS FOR SALE

1-75 h.p., 850 r.p.m., 230 or 500 volt d.c., General Electric motor; complete with pulley and starter.

2-50 h.p. and 1-30 h.p., 3-phase, 60-cycle, 865 r.p.m., 220 or 440-volt Crocker-Wheeler motors with starters. These three motors are new and can be had at a bargain.

1-30 h.p., 3-phase, 60-cycle, 675 r.p.m., 220 volts, Crocker-Wheeler.

1-25 Western Electric, 2300-volt, 3-phase, 60-cycle, 1140 r.p.m.

2-15 h.p., G. E. 60-cycle, 3-phase, 1200 r.p.m., 2220-volt.

2-30 h.p., Westinghouse d.c., 900 r.p.m.

2-15 h.p. 2-phase, 220 G. E.

1-25 h.p. 3-phase, 220 Westinghouse.

4-5 h.p. single-phase, Wagner, 110/220.

1-15 h.p. 850 r.p.m., 3-phase, 60 cycles, Westinghouse.

1-5 h.p. 3-phase, 60 cycles, vertical type 220-volt Westinghouse.

1-5 h.p. type C, variable speed, with controller, Westinghouse.

1-5 h.p. 3-phase, 60 cycles, slip ring variable speed, G. E.

1-10 h.p. 3-phase, 60 cycles, 440 V. Ideal.

HAMPTON ELECTRIC & MACHINERY COMPANY
518 and 522 Mission St.,
San Francisco

Rates on this page are
$1.00 for 25 words,
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additional

Advertisements for the *Clearing House Section* can be received until 22nd for the issue of the 1st and until the 9th for the issue of the 15th.

MISCELLANEOUS

Will Pay Cash

for motors of any description. Let me know what you have. Address box 205 Journal of Electricity.

Centrifugal Pumps

2-3 inch centrifugal pumps, direct connected to 5 h.p. motor, in first class condition. Box 703, Journal of Electricity.

Motors Wanted

We are in the market for 2 a.c. motors, about 150 h.p., 3-phase, 440 volts. Give full description and prices in first letter. Box 205, Journal of Electricity.

Blue Prints of Motor Windings

Send $1 for 14 blue prints of motor windings, 10 A.C., single, two and three phase and 4 D.C. or set of 20 A.C., 4 D.C. and 4 rotary converter drawings, $1.60. Windings made easy. Box 195, Martin Electric Co., 136 W. Third Ave., Denver, Colo.

Motors Wanted

Am in the market for several a.c. motors. Let me know what you have; any make from 75 h.p. to 300 h.p., 3-phase, 440 or 2200 volts. Address J. J. Pottinger, contracting engineer, 115 Main St., San Francisco, Cal.

POSITIONS VACANT

Opportunity in California

We have an opportunity in California for an ambitious and capable young engineer, electrical and mechanical; technical graduate, with some shop experience to develop into engineering salesman. Give full experience, age and complete references. Box 705, Journal of Electricity, Crossley Building.

POSITIONS WANTED

Under this heading the rates are 50 cents for 25 words and 2 cents per word additional. Minimum charge 50c.

Graduate Engineer, 33, married, desires permanent position. Ten years' general experience in design construction, maintenance and operation of hydroelectric systems; can handle men and business with tact and ability; salary $1800 Address box 553, Journal of Electricity.

Draftsman, working at home, wants drawings, tracings, etc., to do. Neat, quick, accurate. Correspondence solicited. Box 155, Journal of Electricity.

Young married man, ten years' experience as lineman, foreman and head of meter department with central station company. Two years in charge of new business department; technically educated. References. Address Box 551, Journal of Electricity.

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Course in civil, mechanical, mining and electrical engineering. Thorough, practical, scientific, theoretical and applied electricity, mathematics, and mechanical drawing. No non-essential studies. For young men of character and energy. Write for catalog. Address 1215 Van Ness avenue.

In This Issue *Advance Papers Pacific Coast Section N. E. L. A. Convention with Departmental Discussions of Vital Interest to Engineers of the West*

JOURNAL OF ELECTRICITY

VOL. XXXVIII No. 8 SAN FRANCISCO, APRIL 15, 1917 PER COPY, 25 CENTS

Thumb Rest

— rests the wrist

— makes ironing easier

1917 Model

Hinged Plug Cord Protector

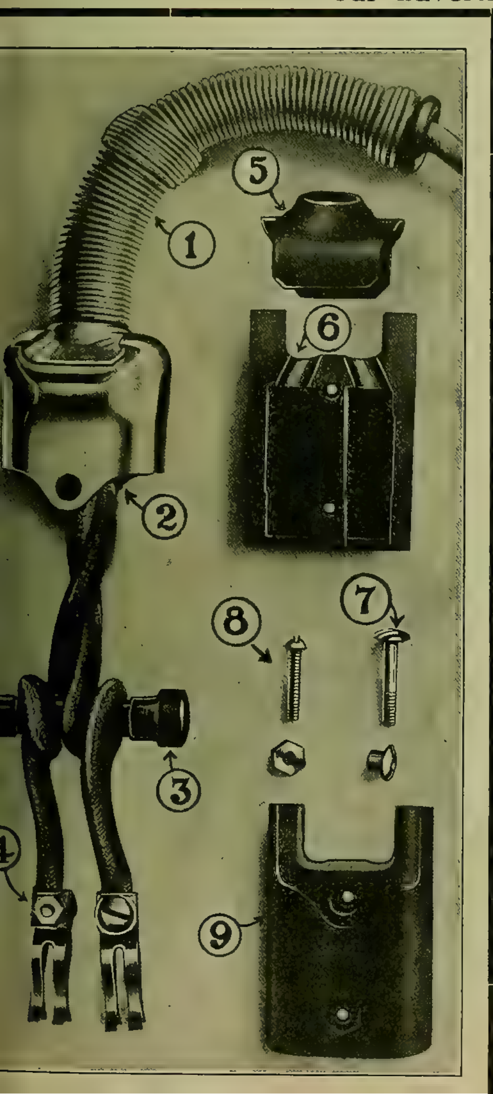
— prevents troublesome cord breakage

— plug easily removable

— plug always cool

WE HELP YOU SELL THIS IMPROVED IRON

by telling the women of the country about it through our advertisements in the leading periodicals



OUR NEXT TWO ADVERTISEMENTS ARE

— a four-color, full page in the May *Ladies' Home Journal* (at news stands April 20th)

— and a two-color, center spread in the April 28th *Saturday Evening Post* (look for it next week—it's on sale April 26th)

THE TWO NEW IMPROVEMENTS

The Thumb Rest appeals instantly to the woman and when she has used it a few days, she would not give it up.

The Hinged Plug and the double Cord Protector eliminate troublesome cord breakage. The grip is always cool and the plug is equipped with new springs, making it very easy to remove.

These improvements mean so much to you men who sell Electric Irons that we are showing a detailed picture of the construction of the plug. Study it. See why cord trouble has been practically done away with.

REFER TO THE NUMBERS ON THE PICTURE

1—Our double protective spring. The outside coil extends about half way, making the lower half more rigid and increasing the bending area of the cord.

2—One piece pressed steel plug cap. It is fitted with a slide hinge joint allowing motion as shown by the picture on the right side of this ad. This still further increases the motion of the cord without wear.

3—A wood plug bar around which the cord is wrapped. This gives a firm anchorage and the pull on the cord is at these wraps rather than where the cord is attached to the springs.

4—Steel contact springs which on account of their shape and temper, are not affected by heat. These springs afford an excellent knife-switch connection. Very easily removed even after long continued service.

5—Fibre insulator lining for steel plug cap (No. 2).

6 and 9—The two halves of composition plug in which contact springs (4) are enclosed.

7 and 8—Screws and nuts for holding plug together.

THE LINE OF LEAST RESISTANCE

Hotpoint Irons are easy to sell because the women know about them and ask for them. We furnish dealer helps of all sorts and our Promotion Department will prepare advertising copy and suggestions for local campaigns.

Write to our nearest office for our 1917 sales plan

HOTPOINT ELECTRIC HEATING CO., Ontario, Cal.

Chicago New York London

Canadian Hotpoint Electric Heating Co., Limited

TORONTO, CANADA


Soldering Iron
Motor Starter
Printing Press Controller
C-H
Drum Controller
A-C Automatic Controller
Push Button Control Station
Automatic Motor Starter
Field Rheostat
Automatic Starter
Crane Protective Panel
Push Socket
Pressure Regulator
Lifting Magnet
Float Switch
Theater Dimmers
Snap Switch
Machine Tool Control Panel
Some of the many types of C-H apparatus is shown above. May we send you further information?
THE CUTLER-HAMMER MFG. CO., Milwaukee
Pacific Coast Agents: H. B. Squires Co., San Francisco—579 Howard St. Los Angeles—San Fernando Bldg.
Seattle—309 First Ave., So.

JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII — SAN FRANCISCO, APRIL 15, 1917 — NUMBER 8

One of the Many Typical Small Farm Units in New Mexico Brought to Life Under Progressive Utility Management

ELECTRIC GENERATION BY PRODUCER GAS

(Producer gas has proved a strong stand-by in certain Eastern centers for electrical development. In the West, due to scarcity of coal supply little has been accomplished along these lines. The coal beds of New Mexico, however, bid well to develop a new and profitable field of usefulness as a home builder in that hundreds of small yet flourishing farm units are being brought to life under irrigation by electrical generation from producer gas. Here is an article that should prove helpful and instructive not only to small central stations, but from it even the larger companies can glean items for future usefulness and inspiration.—The Editor.)

The Gas Producer With Fire Zones

ROSWELL, New Mexico, has the distinction of having a central station which places its main reliance for electric power on producer gas engines and which has taken a leading part in the development of electric power for irrigation pumping. Situated at an altitude of 3600 ft., in the midst of the fertile valley of the Pecos River, in southeastern New Mexico, north of the country where they dig for wood and climb for water, is this city of 8000 people, a modern Mecca for the health-seeker and tourist.

The Roswell Gas & Electric Company serves the electrical needs of the town and of such of the surrounding district as does not possess artesian water. The electrical generating equipment comprises three 250 kw. gas producer sets and a 500 kw. auxiliary steam turbine, the gas producers carrying the load during the irrigation pumping season and the turbine from October to December while the gas engines are being overhauled and also at peak load throughout the year.

The 750 kw. irrigation load is derived primarily from the Berrendo Farms, the oldest of whose apple orchards are bearing fruit for the first time this year. While the 1500 acres of orchard have been coming to the bearing stage, the farmers have been raising livestock and milking cows with success. Half the average forty-acre farm is planted to orchard and the other half to alfalfa and general crops.

All of the houses and barns throughout the tract are completely equipped with lamp-socket electrical devices. Little effort has yet been made to seek the

The Electric Generating Unit of the Roswell Gas & Electric Company, Gas Driven

Exterior View of Power House

electric cooking load, though this offers bright prospects.

The most interesting part of the installation is the high efficiency obtained, the operating results showing 4 kw.-hr. per pound of coal. The coal is a good grade of bituminous, obtained from Ratón, in the northern part of the state.

The success of a gas producer plant, contrary to a steam plant, depends upon the incomplete combustion of the fuel. Whereas a steam engineer bends every effort to minimize the carbon monoxide, the gas engineer tries to avoid making carbon dioxide. Consequently a gas producer is, in some respects, just the reverse of a boiler furnace.

Outdoor Transformer for Farm Service

The six gas producers at Roswell are of the Westinghouse double zone type, with down draft produced by a suction fan at the gas off-take. Each producer consists essentially of a brick-lined steel shell, 17½ ft. high and 10 ft. square. As indicated by the name, it consists of two zones, upper and lower.

Green coal is charged at the top of the upper zone with just enough air to cause coking. The temperature is high enough to distill the hydrocarbons, which are broken down into marsh gas, hydrogen, and carbon as they are drawn down through the coking zone. This gas is drawn off and the carbon (lamp black) and unburned coke drops into the lower zone, to which the air is supplied from below through a tuyere. As the air passes upward through this zone its oxygen is first converted into carbon dioxide as the coke burns, but as this gas rises it unites with the hot carbon to form carbon monoxide. The carbon monoxide from the lower zone is drawn off from the middle of the producer and mixes with the marsh gas and hydrogen from the upper zone, and both are drawn off to the scrubbers.

The ash drops into a shallow pit in the bottom of the producer shell, the pit being filled with water to act as a seal, which makes it possible to withdraw the ash in a cool and dustless state. Steam is used to regulate the temperature in the two zones, being admitted with the air.

The gas is cleaned by a preliminary spraying in the take-off pipe, then passes through the wet scrubber and then through a dry scrubber, being drawn through the producer and scrubbers by a cycloidal blower discharging into the gas distributing main, which supplies the gas engines through a convenient valve system. Duplicate sets of blowers are provided as a service insurance.

These producers supply gas to three 250 kw. Westinghouse gas engine driven generating sets, two of the engines being vertical and one horizontal. In addition there is a 100 kw. gas engine set at the company's gas plant which supplies current in case of emergency.

Every precaution is taken to prevent shutdown. Each engineer and each gas man is paid a $25 monthly bonus if no shutdown occurs, and are penalized $5.00 each time a residence circuit is disconnected. This recognizes the

View of Business Section of Roswell

fact that the quality of the case is equally as important as the handling of the engine in providing continuous service. It is of interest to add that the engineers usually earn their bonus.

Current is distributed at 2300 volts over a well-constructed distributing system, which follows the alleys throughout most of the town. The main streets are illuminated by 140 cast-iron boulevard posts of the three and five-light type. The 60-watt top lights burn all night and the 40-watt pendant lights till 10 p. m. This lighting system was installed by the property owners, the city paying the cost of current and maintenance. The installation is of the straight multiple type, 110 volts, in steel armored cable.

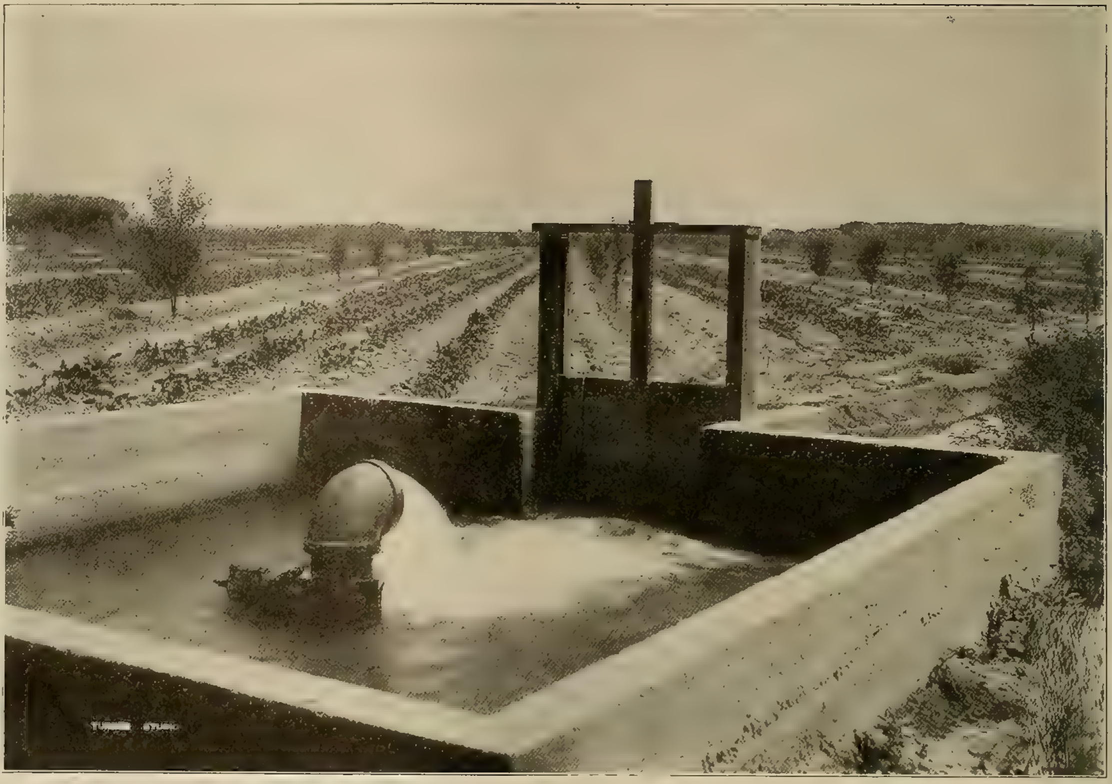
Because of the abundance of artesian water in this vicinity, electric pumping for irrigation has been necessary only on the higher lands for lifts of from 20 to 60 ft. Centrifugal and turbine pumps are used in most installations, driven by motors of from 20 to 30 h.p. Experience is demonstrating that smaller pumps, driven by motors of from 3 to 5 h.p. and pumping continuously into reservoirs, would give a more satisfactory load to the power company and lower bills to the irrigator.

Particularly noteworthy is the type of outdoor substation illustrated herewith. This two-pole support has been standardized so as to promote economy in construction and is giving satisfaction in every way.

Rates are based upon a monthly readiness-to-serve charge of $1.00 per connected horsepower during the irrigation season, plus 4½ cents for the first 500 kw.-hr., 4 cents for the second 500, 3½ cents for the third, and 3 cents for all in excess of 1500 kw.-hr., with 1 cent per kw.-hr. discount for prompt payment of bill.

The far-sighted management under which this unusual utility is operated is doing much to build up the surrounding vicinity with profit to itself and to the community by encouraging the small farm load in every way possible.

The Roswell Gas & Electric Company is owned by the Otis interests of Cleveland, Ohio, D. W. Low being general manager and C. M. Einhart general superintendent. To these gentlemen the writer is indebted for the information published.



Electric Pumping Brings Abundance of Water for Intensive Farm Products

OZONE FOR THE CHILDREN—VI. OR ENGINEERING TWISTERS RETOLD

Many puzzling questions constantly arise in ordinary conversation that often confuse even the engineer unless careful analysis of fundamental principles of mechanics is closely adhered to.

I had the honor of sitting at the captain's table on a transpacific voyage and having overheard a mathematical dissertation going on at the chief engineer's table upon the propeller shaft wherein entered the moment of inertia, the moment of turning effort and so on until I thought the moment for the sinking of the ship had arrived, I laughingly put the following proposition to the skipper: "Captain, if a boat, designed in still water to steam 8 miles per hour, crashes into a log floating in a river which flows 4 miles per hour, would it be a more serious collision if the boat was sailing up stream or down stream?"

Without thinking very seriously the old skipper closed one eye and promptly replied, "Why a head on collision, of course, would be the worst." As a matter of fact, however, an analysis shows that the effective impact of the crash would be the same in either case. Effective impact, depending upon the added velocities of two moving bodies, determines the dangers to be avoided. Since the log flows with the river and the boat flows with the river, the down stream crash is at once seen to be proportional to a velocity of 8 miles per hour. On the other hand, when traveling up stream the boat, if steam were shut off, still flows with the river downstream, and the log flows down stream, so that the boat operating at full speed up stream would still have the same effective crash in case of a collision—namely that resulting from a crash proportional to a speed of 8 miles per hour.

Effective Flood Lighting of Wise Power Plant, situated near Lincoln Highway and Southern Pacific Lines

EXPERIENCE WITH HIGH HEAD FRANCIS TURBINES

BY J. P. JOLLYMAN

(Until quite recently the proposal of a Francis turbine for operation under a four to six hundred foot head would have been considered too daring for safe and conservative design. Here is an article that tells of recent installations that not only employ such heads as this but also operate at over eighty-six per cent efficiency, with penstock pipe lines and their impounded waters stretching back for a distance of over a mile and one-half. The author is engineer in charge of electric construction for the Pacific Gas & Electric Company and has written this paper for consideration at the convention of the Pacific Coast Section of N.E.L.A. at Riverside.—The Editor.)

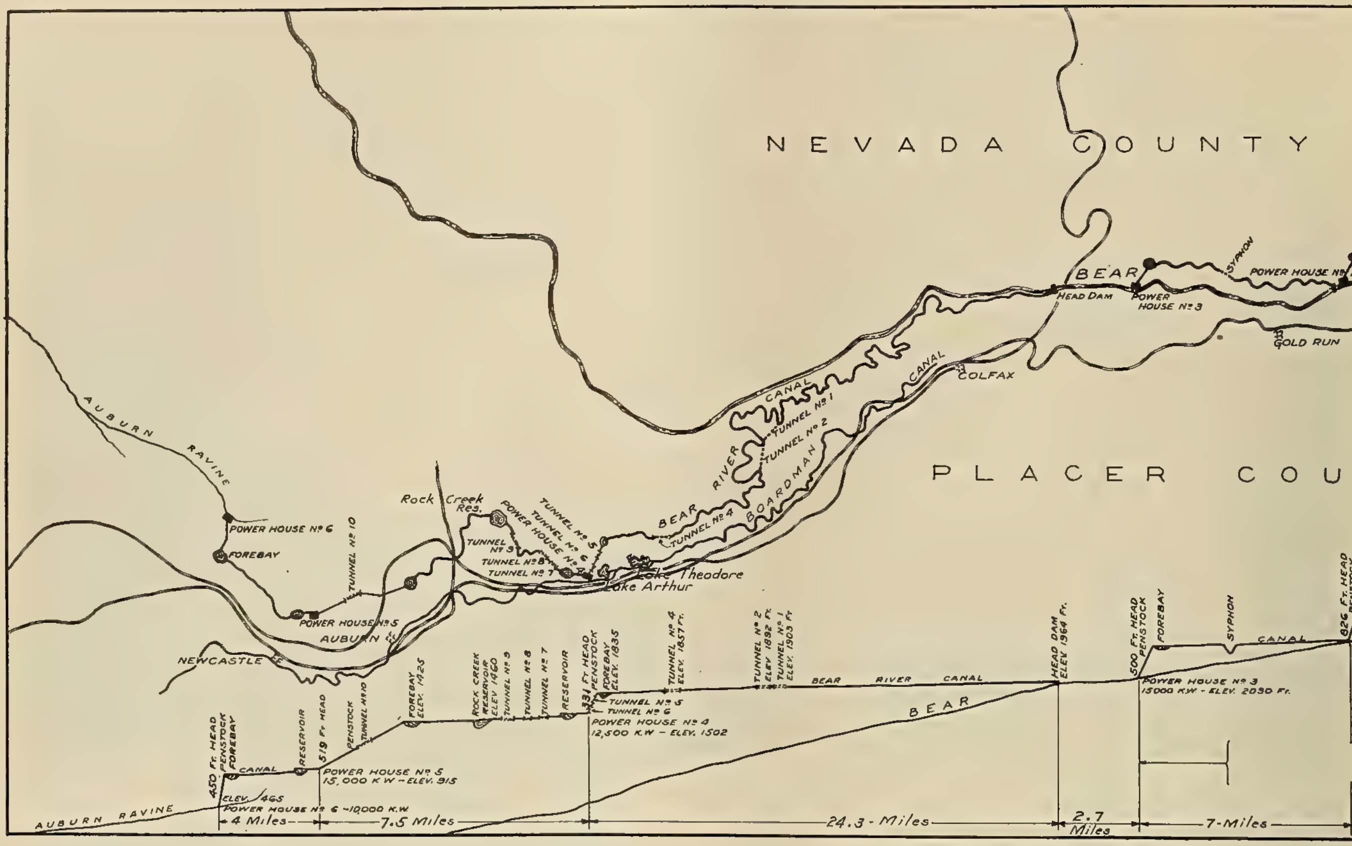
During 1907, at the Centerville power house of the Pacific Gas & Electric Company, we installed an Allis-Chalmers 9000 h.p. 400 r.p.m. horizontal, single discharge turbine under 577 ft. head. The penstock is 2576 ft. long. At the time of its manufacture, this turbine represented a very considerable advance in head compared with anything in service in this country. When first installed some difficulty was experienced in obtaining satisfactory balance against end thrust due to insufficient provision for automatically balancing the runner. A change in the setting of the thrust bearing largely overcame this difficulty and permitted regular operation of the unit.

Careful tests made with a weir showed a maximum efficiency of 86 per cent. This is very satisfactory as it is 2 per cent to 4 per cent better than that of the impulse wheels available at that time.

While the water is fairly clear, some grit is carried at times of storms. Some wear of the runner became apparent within a year, but the efficiency did not drop off until after several years. After seven years of practically continuous operation the wear was considered sufficient to justify renewing the runner, guide vanes and the plates on either side of the guide vanes. The new parts were provided with balancing chambers on both sides of the runner of a design which had been perfected since the turbine was first installed. All end thrust is now taken by the balance chambers and the thrust bearing is only called on to prevent the runner from striking the crown plates when the guide vanes are closed.

After two years of service a few places in the new bronze runner commenced to cut a little. These were filled by the oxyacetylene process.

The Penstock Piping at the Wise Power House
8546 ft. in Length



Map of Spaulding Development showing

This turbine has the very low specific speed of 13; in other words the ratio of runner width to runner diameter is very small as must be the case with any turbine for high head, moderate speed and medium output.

We consider that the success of this turbine removes any doubts we may have had concerning the feasibility of the Francis turbine for heads up to about 800 ft. where the output and speed can be adjusted to give specific speeds of 12 or more.

The governor operated relief valve supplied with this turbine successfully controls the pressure on sudden rejection of load by the turbine. The turbine governor was equipped with a load limit device so arranged that the maximum gate opening of the turbine could be easily adjustable. This was necessary as the plant has practically no forebay and the flow in the canal is subject to some fluctuations. This unit is not called on to govern.

Partly due to the success of the turbine at Centerville, our Halsey power house with 328 ft. head and our Wise power house with 519 ft. head were decided upon as series plants in our South Yuba Development.

Each of these plants is equipped with a single 12,500 k.v.a., 360 r.p.m. generator.

The generator at the Halsey power house is driven by two Allis-Chalmers 9000 h.p. horizontal single discharge turbines whose runners are mounted directly on the overhung ends of the generator shafts. This plant was put into service December 6, 1916, so we have had no experience with wear as yet. The plant has been given a thorough tryout under all loads and under sudden rejection of load. The balancing of the turbines and the action of the governor-operated relief valves is very satisfactory. The penstock is 5418 ft. long and has no stand pipe or air chamber. As at Centerville, the governors are controlled by load limit devices. These turbines have a specific speed of 24.5 and are not extra high head. Preliminary tests indicate that the maximum guaranteed efficiency of 86 per cent has probably been exceeded.

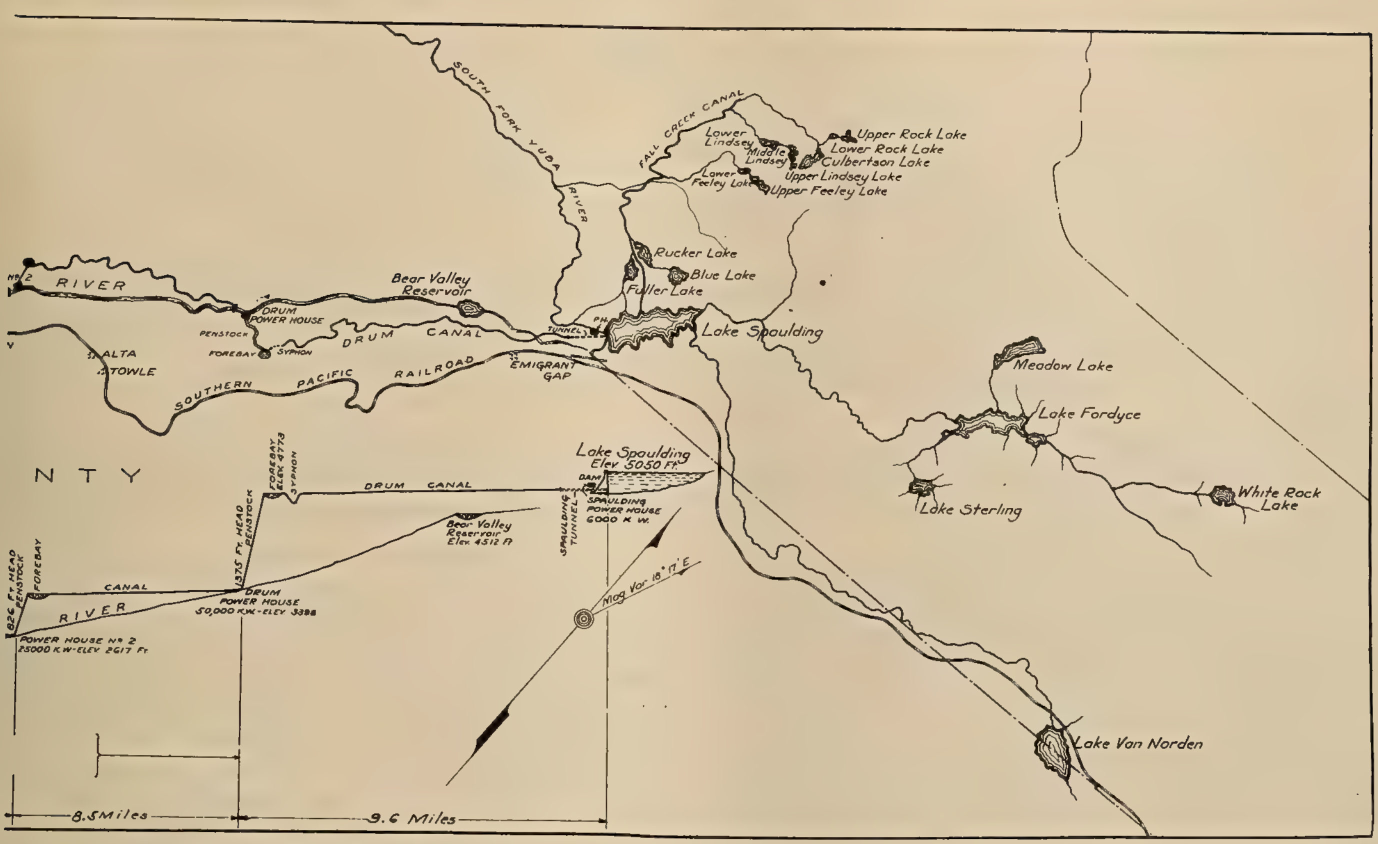
The generator at the Wise power house is driven by one Pelton-Doble 18,000 h.p. single discharge turbine over-hung on one end of the generator shaft. This turbine has a specific speed of 20 and is believed to have the largest output of any single discharge horizontal turbine yet constructed. The penstock is 8546 ft. long and has no stand pipes or air chambers. The turbine is equipped with a governor-operated relief valve. This plant was put into service March 4, 1917, and was immediately given a careful tryout under load and for behavior under sudden loss of load. As high as 10,000 kw. was dropped instantly with a penstock pressure rise of 11 per cent. In view of the long penstock this result is regarded as very good.

The turbine operates smoothly when under load, and the balance against end thrust is good. Here again the governor is controlled by a load limit device.

Preliminary tests indicate that the guaranteed efficiency of 86 per cent has been exceeded.

When it is remembered that at 519 ft. head and 360 r.p.m. a single jet impulse wheel could develop only about 1000 h.p., the simplicity and desirability of a single 18,000 h.p. turbine is very apparent.

We shall watch the performance of these two new plants with great interest, but have no doubt of their success in view of the success of our Centerville plant.



Drum, Halsey and Wise Power Plants

GOVERNMENT REGULATION OF GERMANY'S WATER POWER

In the division of government powers in Germany between the federal and state jurisdictions the regulation of waterways and waterpower development falls to the states. The most important legislation on the subject comprises laws enacted by Hesse in 1887, Alsace-Loraine in 1891, Baden in 1899, Wurtenberg in 1900, Bavaria in 1907, Saxony in 1909, and Prussia in 1913.

It has been the policy of Prussia in the past to leave the development of waterpower sites to private or local communal enterprise. More recently, however, a reversal has taken place, and the State has itself intervened to build power plants and undertake the distribution of the power developed. This has already been done on the Lippe at Hamm, on the Weser at Dorveden, and at certain places on the upper reaches of the same stream.

Under the scheme that has been followed in the development of the waterpower sites on the upper Weser, the state appropriates the amount needed to construct the hydroelectric plant, together with auxiliary works such as locks, etc., and for the erection of the transmission system for distributing the electricity.

The government is authorized to obtain the money appropriated by the issuance of bonds to the amount of the appropriation, or by the issuance of treasury notes. The actual work of construction is carried out by the waterways department of the Ministry of Public Works, and the subsequent operation of the completed plant, and its business administration remain in the same hands.

MEASURING GROUND-WATER SUPPLIES

In few places is water more valuable than in the well-known Santa Clara Valley, Cal, where large supplies are pumped out of the earth for the irrigation of prunes and other crops and for use in the cities on San Francisco Bay. For several years investigations to determine the quantity of underground water annually available for use in this valley have been made by the Department of the Interior through the Geological Survey in co-operation with the California State Department of Engineering. In 1915 a report by W. O. Clark, published by the Survey, gave an estimate of the supply in the area known as the Niles cone, and a similar report is now announced for the area around the village of Morgan Hill.

The ground-water level in the Morgan Hill area rises during the rainy season 10 to 45 ft., or an average of about 19 ft. As the water-bearing materials underlie about 15,700 acres of the area and have an estimated available porosity of about 12 per cent, it was calculated that this rise in water level requires a storage of ground water during the rainy season of about 34,000 acre-feet, or practically sufficient to meet the needs of irrigation if the area is planted to orchard.

Recently four gaging stations have been established at points along Coyote River to determine how much water this stream loses by percolation into the gravel deposits that underlie the Morgan Hill area. These determinations will form a check on the estimates based on rise of water levels.

The report on the Morgan Hill area, which is known as Water-Supply Paper 400-E, can be obtained free of charge by applying to the Director, United States Geological Survey, Washington, D. C.

RATE MAKING

BY W. G. VINCENT, JR.

(The subject of flat rates and socalled straight meter rates has been one of much thought and study on the part of engineers of the West. Here is the embodiment of a combination of these two fundamental principles of rate making, that should prove immensely helpful to utility companies throughout the West, in that it has evolved itself from problems that are peculiar to this section of the country. The author is evaluation engineer for the Pacific Gas & Electric Company and will present this paper at the convention of the Pacific Coast Section of N.E.L.A at Riverside.—The Editor.)

In discussing rate questions, misunderstandings often arise from the use of terms that are not clearly defined; therefore it has been thought advisable to begin this paper by defining a few expressions whose meaning may not be entirely clear to many who do not use them frequently.

From the Standardization Rules of the American Institute of Electrical Engineers the following definitions are cited:

"**The Load Factor of a Machine, Plant or System.**—The ratio of the average power to the maximum power during a certain period of time. The average power is taken over a certain period of time, such as a day, a month, or a year, and the maximum is taken as the average over a short interval of the maximum load within that period.

"In each case, the interval of maximum load and the period over which the average is taken should be definitely specified, such as a 'half-hour monthly' load-factor. The proper interval and period are usually dependent upon local conditions and upon the purpose for which the load factor is to be used."

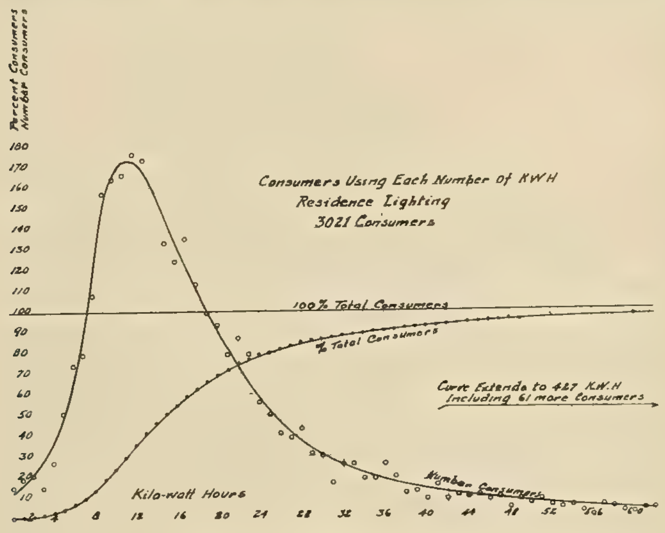


Chart for Residence Lighting

"**Plant Factor.**—The ratio of the average load to the rated capacity of the power plant, i.e., to the aggregate ratings of the generators."

"**The Demand of an Installation or System.**—The load which it puts on the source of supply, as measured at the receiving terminals. The demand may be as specified, contracted for, or used. It may be expressed either in kilowatts, kilovolt-amperes, amperes or other suitable units."

"**The Maximum Demand of an Installation or System.**—Its greatest demand, as measured not instantaneously but averaged over a suitable and specified interval, such as a 'five-minute maximum demand.'"

"**Demand Factor.**—The ratio of the maximum demand of any system or part of a system, to the total connected load of the system, or of the part of system, under consideration."

"**Diversity Factor.**—The ratio of the sum of the maximum power demands of the subdivisions of any system or parts of a system to the maximum demand of the whole system or of the part of the system under consideration, measured at the point of supply."

"**Connected Load.**—The combined continuous rating of all the receiving apparatus on consumers' premises, connected to the system or part of the system under consideration."

Origin and Development

Many of those now operating electric utilities can recall the history of these utilities from the beginning and have seen in a few years the origin, development and transition of the rate situation almost without realizing what was going on. This development and transition has all occurred within a very few years and is practically identical with what has occurred elsewhere in electric rates and also in gas rates, though in the latter case over a much longer period.

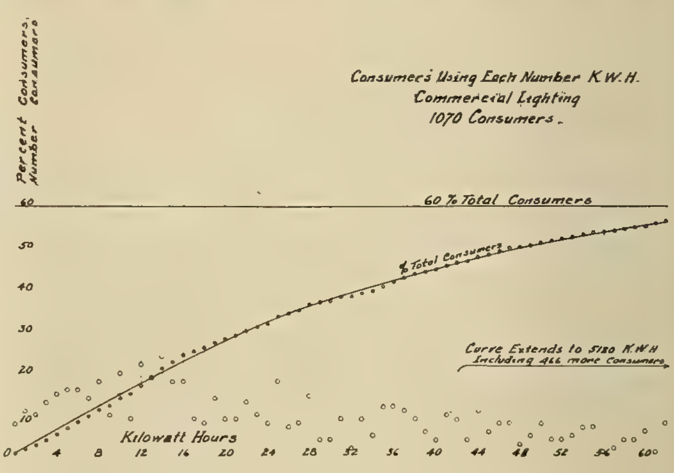


Chart for Commercial Lighting

In the beginning there were no meters, all electric service was supplied on flat rates, which was the only available method of charging. These flat rates were demand rates, i.e., the charge was based entirely upon the consumer's demand. It was soon recognized that this method was wasteful and unfair, and with the development of the meter, flat rates were in general superseded by meter rates of the "straight" type. Owing to the large water power development, and the slowness to appreciate the importance of diversity factor, flat rates have persisted on the Pacific Coast even down to the present time, although they are now fast disappearing.

After first trying flat rates and finding them inadequate and then "straight" meter rates and finding that they did not meet all of the requirements, the next step was to develop a rate which would embody the desirable features of both. The earliest form of such a combination was known as a "differential rate" in the

gas industry and consisted of a rate carrying discounts of one kind or another for the larger quantities, such as in our present "step" and "block" rates. Later there were developed many other forms, using as a basis a fixed charge determined by the demand and a variable charge dependent upon the energy used.

Costs Analyses

During the early consideration of the problem, there were contributed to the literature on rates several papers and articles which have remained to this day as classics, enunciating as they do the fundamental principles of rate making, and around which practically all discussions have since centered. While it is not intended in this paper to go into the details of the ideas presented in these papers, it is not possible to discuss the subject at all without at least briefly mentioning a few of them.

Dr. Hopkinson in 1892 analyzed for the first time the costs of electric utility operations and pointed out very clearly that a large part of the charge should be placed upon the demand of the consumer and the balance upon the energy used. It seems probable that prior to the presentation of this analysis by Dr. Hopkinson any variations from the flat or straight meter rates that had been made were due to expediency rather than to competent analysis.

Mr. W. J. Green of New York, in an article in the Electrical World in 1896, analyzed very carefully the cost of supplying electricity, and for the first time brought out the importance of the expenses occasioned by the consumers, independent of their demands and the energy required by them. This analysis developed the basis for what has since been called the three charge system, consisting of consumer, demand and energy charges.

In 1896 Mr. Arthur Wright first described the Wright Demand System in a paper presented before the Municipal Electrical Association, Whitehall, England. This system had been put in practice in England as early as 1893 along lines somewhat similar to those adopted by Mr. Green. The basis of apportionment of expenses used by Mr. Wright was quite similar to that used by Dr. Hopkinson, both placing all the investment charges and expenses, independent of the actual output of the plant, into what was called by one a "Readiness-to-Serve" and by the other a "Demand" charge. Dr. Hopkinson using the installations as a basis for pro-rating this readiness-to-serve charge between the different consumers, and Mr. Wright's theory was that these charges were to be divided proportionately to the maximum demand of each consumer at the time of the station peak.

In 1900 Mr. Henry L. Doherty in a paper before the National Electric Light Association laid down the principles of the three charge rate, which he had successfully applied in practice.

The work of these men and many others has defined the principal factors affecting the costs of supplying electricity, and other classes of utility service, such as water, telephone, gas, etc., as well as other lines of business in which their analogies are found. These factors which affect and largely determine the cost of supplying service by every electric utility, briefly stated, are:

First—The number of consumers supplied.

Second—The maximum demand upon the plant made by the consumers.

Third—The amount of electricity required by the consumers during a given period of time.

The influence of these three variables on costs is generally recognized and in all complete cost analyses they are used as a basis for segregating expenses. There is, however, some difference of opinion as to their relative influence on the various classes of costs, but on the whole these differences are matters of detail and do not affect the general principles involved.

Every utility should make a complete analysis of its operating and maintenance costs and fixed charges, as only with this knowledge can the utility deal intelligently with many of the problems covering rates, extensions, reconstruction, etc., that confront it from day to day.

Basis for Rate Fixing

While the proper basis for fixing rates is still a matter for discussion and very few of the regulatory bodies have committed themselves to any definite rules on this subject, it must be admitted that the method most commonly employed by regulatory bodies is based primarily on cost, the value of the service and other elements being considered only when it has been found that the cost theory consistently followed, would not produce the best results for all concerned. As illustrating this method we may refer to the San Jose Electric Rate Case where, after determining the total cost of serving all classes of consumers, the California Railroad Commission then analyzed this total and segregated it between the costs of supplying several of the principal classes of service, such as street lighting, street railway, residence and commercial lighting, industrial and agricultural power, etc. After comparing the result of this segregation with the revenues from each class, it found that while the lighting revenue exceeded the costs, on the other hand the industrial and agricultural power revenue was less than the expense charged to these classes. The commission reduced the lighting rates but still left a margin above the costs about equal to the loss in the power business, leaving the power rates unchanged, Commissioner Thelen saying in the decision:

> "While I am of the opinion that each class of business should at least yield a revenue such as would not under average conditions create an additional burden upon the other classes of consumers, it does not necessarily follow that all classes of service should show the same degree of profit or yield the same percentage of return as every other class."

> "While it appears from the segregation of costs hereinbefore made that the residence and lighting business will produce a net revenue materially in excess of its segregated charge, it by no means follows that the same conclusion wou'd be true if, through an increase in the rates for agricultural power, defendant should lose a considerable part of this class of business."

The above is quoted for the purpose of showing that the commissions recognize the necessity of considering the existing conditions and that it is not practicable in all cases to establish a system of rates worked out from a purely theoretcal standpoint.

The United States Supreme Court in its decision, the so-called North Dakota Lignite Coal case, dis-

cussed the question of class rates and the following comment on this decision from the report of the Rate Research Committee of the National Electric Light Association for 1916 will be found of interest:

"The court holds that a state cannot compel a railroad to carry a preferred class of freight at a rate (specified by the state) which merely returns the increment cost of the service. The court holds that when the state undertakes to establish a rate for a given class of service, the costs pertaining to that class must be determined, assigned and charged thereto and that overhead and general expenses must be fairly apportioned between that class and all other classes. The intent of the rate which was set aside by the court was to develop the lignite coal industry in the state of North Dakota. In setting it aside the court painstakingly avoided saying that the railroad might not make such a rate with such an intent if it so pleased. The dictum is, that broad as is the state power of regulation, nevertheless the state does not enjoy the freedom of the owner of the public utility in such matters.

"In the same decision the court after having thus stated the cost of service theory, guards against the foolish application of that theory by the following language:

'The legislature undoubtedly has a wide range of discretion in the exercise of the power to prescribe reasonable charges and it is not bound to fix uniform rates for all commodities or to secure the same percentage of profit on every sort of business. There are many factors to be considered—differences in the articles transported, the care required, the risk assumed, and the value of service, and it is obviously important that there should be reasonable adjustments and classifications.' "

"There are two lessons for us in this decision. First, that in making a rate for a specified service we must truly know the costs of our service; not only the costs directly pertaining to that class but the reasonable proportion of overhead and general expenses which should be borne by that class. We do not suggest amplified classifications. The decision contemplates 'reasonable adjustments and classifications' which we interpret to mean those indicated by common sense. Neither do we offer any rule or method of analysis—these are matters beyond the scope of this committee. Our point is that the making of any classification, be it broad or narrow, implies a co-existent analysis of costs by like classes.

"The second lesson is that the highest court rejects the contention of the extreme theorist who insists that we should obtain the same percentage of profit on every sort of business, or (it may be) on the business of every individual customer; and equally rejects the contention of the ignoramus or mischief maker who clamors for identical rates for all services. It is no longer necessary to caution our membership against either of these errors, but we note that the extreme theorist and the mischief maker are not dead, and that we have had to listen and reply, even in the past year, to the man who wants us to sell all our service on a single straight line kilowatt-hour rate, and to the other man who wants us to determine so exactly the cost of service to each customer that our power plants and distribution systems would become merely unavoidable preliminaries to the operation of a meter department."

Rate Schedules

A rate schedule is a set of rules for billing consumers for service, and the principles or theories upon which it is based are not complex and may be expressed in simple terms. Whatever complications appear are more often introduced in an effort to develop a system of charging consumers with varying requirements for the amount which each should pay, and are not inherent in the basic principle upon which the schedule is predicated. There are really two questions involved, the theory of rates and the art of bill making.

In the early days of the electric utilities when the number of consumers was small, and the classes of service few, the rate schedule was a simple matter to prepare, but as the business developed and not only the classes of consumers increased but the individual requirements of consumers in the same class enlarged and extended, the rate schedule has of necessity become more elaborate in order that it should adequately fulfill its function.

In addition to the general growth of the business, another factor affecting electric utilities which has had a very decided influence upon the schedule is public regulation and particularly regulation by commissions where uniform rates must be filed and "deviations" are not permitted. Before these requirements were made, the making, changing, withdrawing and interpreting of schedules was almost entirely in the hands of the utilities, and adjustments found necessary or desirable could be made at will. Under commission regulation this is a more difficult procedure and hence it is necessary that the rates should be very carefully phrased and specify explicitly what they are not intended to cover, as well as what they are intended to cover.

Two recent commission decisions, one by the Montana Commission and one by the New York Commission (2d district), are of interest, as indicating difference of opinion between commissions and also as indicating the necessity for defining clearly to what class of service a schedule is applicable.

Both cases involved the question of whether a moving picture theatre was entitled to the power rate for operating a motor generator. The Montana Commission decided the power rate should be given, provided the power was not used to generate electricity to be used for general illumination. The New York Commission decided the power rate applied, even if the power was used to operate a motor to drive a generator to supply electricity for general illumination.

A rate schedule should, if possible, be of such a form and so expressed that it may be easily understood by the consumer, but under the conditions already referred to this is becoming more and more difficult, and its importance after all may have been over-estimated. In other words, considering the wide range of conditions that we have to design our rates to meet, are we not expecting too much when we also require that they be "easily understood by the consumer?" Even if we sacrifice many other things in order to attain this end, will the consumer really endeavor to understand them, or are our sacrifices made in vain?

A consumer asking for a power rate should not merely be handed a schedule designed for the purpose of billing thousands of consumers with wide diversities of requirements, and so worded as to condense the expression of many ideas and definitions, often of necessity technical, in a minimum space, but he should also be given either verbally or, preferably in memorandum form, an interpretation of the schedule in terms of his individual requirements. This is what the consumer wants and can be made so simple as to be easily understood by him. Every solicitor or other employee

who constitutes a point of contact between the consumers and the utility should thoroughly understand the schedules and be able to interpret the application of a general rate into very simple terms for any specific case. This is a very important matter that in many cases does not receive the attention that it should from those operating utilities.

Types of Rates

The descriptions and illustrations of the principal types of rates in general use, that have recently been published as a preface to the N. E. L. A. Rate Book, and which were also published in the N. E. L. A. Bulletin for February, 1917, will be found of interest to all concerned with rate questions.

(From City of Lincoln vs. Lincoln Water & Light Company. Complaint as to Rates for Water and Electric Service. Decision of the Illinois Public Utilities Commission, Fixing Rates. November 28, 1916).

As indicating some of the factors which must be considered in fixing lighting rates, the results of an analysis of the characteristics of a fairly large group of lighting consumers, which was made a few years ago, may be of interest.

In connection with a rate case an inspection was made of the connected load of a number of lighting consumers, both residence and commercial, and their actual consumption taken for an average month, from which data the following tables were compiled.

Types of Electric Rates Used in the Larger Cities †

Type of Rate	Residence Lighting No. Cities	Residence Lighting Population Served	Commercial Lighting No. Cities	Commercial Lighting Population Served	Retail Power No. Cities	Retail Power Population Served
Meter Rates:						
Straight Line Meter Rate........	*24	3,062,063	*8	882,699	*14	1,765,516
Block Meter Rate................	*40	9,063,383	*35	7,274,188	30	7,251,082
Step Meter Rate..................	*14	1,199,830	11	791,977	13	1,032,978
Demand Rates:						
Wright Demand Rate Regular....	23	7,045,899	39	10,850,588	42	11,608,721
Room Basis of Demand...........	9	2,308,743	..	....	..	....
Socket Basis of Demand..........	1	233,650	..	....	..	....
	33					
Hopkinson Demand Rate.........	1	48,443	18	2,944,410	12	1,085,565
Three-Charge Demand Rate......	...	....	1	218,149	1	218,149
Total	112	22,962,011	112	22,962,011	112	22,962,011

*Each of these includes one city where the rate is made up of a small monthly customer charge in addition to the energy charge.

†From "Rate Letter" of Norton, Bird and Whitman—September, 1916.

As illustrating the diversity in the form of rates charged in the larger cities, the following table is of interest:

Present Problems

Among some of the larger rate problems confronting utilities as well as commissions may be mentioned the following:

Lighting Rates.—What form of lighting rate should be adopted? Should there be a different schedule for residence and for commercial lighting?

On this last question it is of interest to note that while several of the commissions have made one rate apply to both classes of service, the Illinois Public Utilities Commission has recently expressed its opinion on this subject as follows:

"The respondent's existing electric rate schedules do not differentiate between the residential and commercial (or business-house) lighting service—a customary differentiation in classification among electric utilities; and this commission believes it to be a proper differentiation, due to inherent characteristics which render the average residential consumer proportionately more costly to carry than the average commercial lighting consumer. In the schedules fixed hereinafter, the commission, for the reason given has established separate classifications for residential and commercial consumers, where a single classification previously existed in the city of Lincoln (unless it may be considered that the previous different percentages of connected load, for a determination of maximum-demand, constitute a different classification)."

"By not differentiating between electric rates to residential and commercial consumers, in effect, there results a disproportionate assessment of costs to the two classifications. An exhaustive study of the fixed charges and operating costs herein, and an extensive analysis of the characteristics of the said classifications, disclose that the unit costs of serving residential consumers in the city of Lincoln are slightly higher than the unit costs of serving commercial consumers."

Table I.
Residence Consumers

Consumers	Conn. Load Limits (Watts)	Conn Load Lighting	Power Consumed kw.-hr.	Hours Use Full Conn Load	kw.-hr. Used per Consumer	Average Connected Load
26	0-250	5,033	420	83.5	16.2	193
105	251-500	42,125	1,827	43.4	17.4	400
349	501-1000	261,111	6,052	23.2	17.4	748
132	1001-2000	170,257	3,251	19.1	24.4	1,290
23	2001-4000	59,225	943	15.9	41.0	2,570
5	4001-8000	24,841	430	17.3	86.0	4,968
640		562,592	12,923	23.0	20.2	880

Table II
Commercial Consumers

Consumers	Conn. Load Limits (Watts)	Conn Load Lighting	Power Consumed kw.-hr.	Hours Use Full Conn Load	kw.-hr. Used per Consumer	Average Connected Load
97	0-250	16,508	1,582	96.0	16.3	170
150	251-500	56,429	5,168	92,0	34.4	376
243	501-1000	175,034	13,169	75.0	54.1	720
220	1001-2000	320,860	25,642	80.0	116.4	1,460
119	2001-4000	337,817	23,321	69.0	196.0	2,830
59	4001-8000	334,014	22,136	65.2	375.0	5,660
40	8001- +	821,205	46,471	56.5	1161.8	20,530
928		2,061,867	137,489	66.5	148.0	2,220

Table III
Residence and Commercial Consumers

Consumers	Conn. Load Limits (Watts)	Conn Load Lighting	Power Consumed kw.-hr.	Hours Use Full Conn Load	kw.-hr. Used per Consumer	Average Connected Load
123	0-250	21,541	2,002	93.0	16.3	175
255	251-500	98,554	6,995	71.0	27.4	386
592	501-1000	436,145	19,221	44.0	32.5	737
352	1001-2000	491,117	28,893	59.0	82.2	1,390
142	2001-4000	397,042	24,264	61.0	171.0	2,800
64	4001-8000	358,855	22,566	63.0	352.0	5,600
40	8001- +	821,205	46,471	56.5	1161.8	20,530
1568		2,624,459	150,412	57.2	96.0	1,675

While the consumers used as a basis for the above tables were considered as representative, they were not all of the consumers in the city in question. A further analysis of the consumption of all of the consumers was made for an average month and the results showing separately for residence and commercial consumers are shown graphically on two charts. On each chart are two curves, one representing the number of consumers using each number of kilowatt-hours and the other curve the percentage of the total consumers using not more than each number of kilowatt-hours.

It is interesting to note on the chart for residence consumers that while the average consumption was about 20 kw.-hr., about 70 per cent of the consumers were using less than the average, 50 per cent using not over 15 kw.-hr., and there were more consumers using approximately 12 kilowatt-hours than any other quantity.

This indicates the danger of dealing with averages, for if we were to make a combination one meter lighting and cooking rate of the block type, of 20 kw.-hr. at a top rate to take care of the lighting, and then apply this rate to the lighting consumers shown on the chart, we would find that only 93 out of 3021 consumers are using 20 kw.-hr. for lighting, while 2000 of the consumers would have to do some of their cooking on the top rate block designed for lighting and 931 would do some of their lighting on the low rate block designed for cooking.

Heating and Cooking Rate.—This is a comparatively new development and an analysis of the rates made for this class of service during the last few years by various utilities and commissions indicates the wide divergence of opinion that still exists as to the most desirable form of rate. Some of the questions concerning rates for this class of service are: What form of schedule is best? Shall we make a one meter rate in combination with the lighting load? What shall we make the top rate? Are we justified in making a lower rate for this service than for small power? How can we handle water heating?

There are also some important engineering problems to be considered in connection with the handling of a large amount of business of this class and on which we have very little data to work.

Agricultural Power Rates.—Here again is a comparatively new development in the use of electricity, which introduces special problems due not only to the class of service required and its isolated location, but also to the radical differences in local conditions.

This paper, which has been hastily prepared primarily for the purpose of opening the discussion on this large subject, has been purposely confined to the consideration of some of the general problems of rate-making, recognizing that there are many other questions of vital importance to be studied, and it is hoped that they will be brought out in the discussion.

WATER RESOURCES OF THE NORTH PACIFIC

The United States Geological Survey, Department of the Interior, has published as Water-Supply Paper 393 its annual volume for 1914 showing the results of measurements of the principal streams in the Snake River basin. The field work was done by the Federal Survey in co-operation with the states of Idaho, Oregon, Nevada and Washington. Gaging stations were maintained during the year at more than 150 points. These records of the behavior of rivers throughout a year and year after year are of the utmost importance to engineers who are considering projects for obtaining a supply of water for irrigation, power, or any other purpose.

A copy of the report may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

ELECTRIC ACTIVITY IN ORE DEPOSITS

The marvelous accomplishments in electric science have far surpassed anything that men would have dared to predict in the early days of its development, yet certain prophecies in regard to it have remained unfulfilled. Among these are the suggestions of some geologists that electric phenomena might play an important part in the formation of ore deposits and that electric methods might be utilized in prospecting for ore bodies. Both these suggestions, in the light of the growing knowledge of ore deposits and of electricity, appear to be illusions. It is now clear that the great causes of ore deposition are not electric in the ordinary sense and that the electric currents generated in ore deposits are far too small to aid a prospector in discovering ore by their influence on a galvanometer or other electric apparatus held in his hands.

If however electricity is denied a leading part in the formation of ore deposits its action can not be excluded entirely. It is well known that many chemical reactions are capable of developing measurable electric currents, and it should therefore be expected that in places where chemical action is in progress in ore deposits today electric activity should also be detectable. This has indeed been shown to be the case by several experimenters, and miniature batteries can be formed with water for the battery fluid and certain metallic minerals common in ore deposits as the poles. A report entitled "Electric Activity in Ore Deposits," by Roger C. Wells, recently issued by the United States Geological Survey, records a series of careful measurements of the electric potentials developed when various metallic minerals common in ore deposits are in contact with water or with solutions of various salts. Mr. Wells concludes that the character of the solutions has fully as great an influence on the electric activity developed as the nature of the metallic minerals and that in general acid and oxidizing solutions give the highest potentials and alkaline and reducing solutions the lowest. Economic geologists have long recognized that the solutions in the upper oxidized portion of many ore deposits are acid and oxidizing, while farther down they become neutral or alkaline. Whether such variations and electric differences dependent upon them are sufficient to cause an appreciable electric current to flow from the upper part of an ore deposit to a lower part or vice versa is still an open question. Surely such action, if it exists, is of relatively minor importance in controlling ore deposition, the main factor being the actual movement of metal-bearing solutions from one place to another. Measurements of electric potential can, however, be quickly and easily made and may prove very useful in indicating the direction and intensity of the chemical reactions of which they are one expression.

SUMMARY FOR RECLAMATION WORK, 1916

The United States Reclamation Service furnished water for irrigating about 1,000,000 acres of land; has available reservoir capacity of 9,000,000 acre feet; has dug nearly 11,000 miles of canals and drains; and built 100 storage and diversion dams, as follows:

	No.	Volume
Masonry	42	2,000,000 cu. yds.
Earth	39	10,000,000 cu. yds.
Rockfill and crib	19	1,000,000 cu. yds.
Total	100	13,000,000 cu. yds.

A SYMPOSIUM ON DISTRIBUTION PRACTICE

(Unusual features experienced nowhere else in the world are encountered in irrigation service of the West in the use of transformers, distribution fuses, switches and insulators. Here is a symposium on such practice in the West invaluable to the electrical engineer. These papers have been written for consideration at the Pacific Coast Section Convention of N. E. L. A. at Riverside.—The Editor.)

DISTRIBUTION CUT-OUT AND TRANSFORMER PRACTICE

BY R. E. CUNNINGHAM
Superintendent of Electrical Distribution
Southern California Edison Co

The necessity for furnishing electric service to the rural and semi-suburban districts of Southern California, on account of the scattered load and the distances to be covered, has compelled the Southern California Edison Company to adopt 11,000 volts for primary circuit. With such voltage it is possible to distribute considerable load over a wide territory with moderate sized conductors and give good regulation.

Originally lines were extended principally for supplying power for pumping plants, but in more recent years there is a large demand for lighting and power for cooking and heating purposes.

Fig. 1. Single-Phase Transformers for 11,000 Volt Lines

Fig. 2. Three-Phase Service for 11,000 Volt Lines

The present system includes 753 miles of 11,000 volt construction with 2400 transformers, ranging in size from 2 to 100 kilowatts. The methods of construction are much the same as used for 2200 volt lines with the addition of greater clearances and increased insulation. The proper protection of transformers and branch lines has been much the same vexing problem as with the 2200 volt system, very possibly to even a greater extent than on the lower voltage line on account of the higher voltage difficulties.

In more recent years we have been using the Pacific Electric Manufacturing Company's fuse holder, Cat. No. 1013 on installations of single-phase transformers for light, heat and small power service. The fuse consists of a Bakelite tube ¾ in. in diameter, 12 in. long, with metal cap at each end to which aluminum fuse wire is attached and led through the center of the tube. Tubes are filled with plaster of paris or other fire resisting powder. Some of the Schweitzer & Conrad liquid type fuses have been used but considerable trouble was encountered with them on account of the fact that glass tubes were easily broken and also due to the tension of the spring the fuse would break without other cause. We have occasional burn-outs with the Bakelite tube fuses, but a reasonable amount of trouble must be expected with any type of fuse protection, and greater expense for more reliable type of protection for single-phase loads we believe would be unwarranted.

Fig. 1 shows method of hanging 11,000 volt single-phase transformer with its fuses.

For three-phase service we have used the Pacific Electric Manufacturing Company's fused pole top switch, Cat. No. 413. Such an installation is shown by Fig. 2. With this arrangement transformers can be disconnected by the consumer at times when the plant is not in operation and thus prevent unnecessary transformer core loss. In case it becomes necessary to replace one of the high tension fuses the switch is opened by the troubleman before climbing the pole so he is not called upon to work on energized apparatus. We have had many cases where one of the fuses would blow, leaving the motor operating single-phase and in some cases the burn out of the motor or transformer has resulted.

Fig. 3. Details for Three-Phase Out-door Switch

The cost of fuse renewals and the expense of troublemen and transportation in taking care of these troubles is a considerable item in a year's operation. On account of these disadvantages we have arranged with one of the local manufacturers to make for us an automatic outdoor type three-pole oil switch for use on three-phase power installations. The details of construction of this switch are shown by Fig. 3 and 4. The dimensions of the oil tank are, width 12¾ in., length 20 in., depth 17 in.

It will be noted that the switch is of simple design, having few moving parts and three series trip coils mounted directly on the switch blades. The advantage of this type of protection is that it is impossible for motor to run single-phase, as trouble in any wire of the three-phase circuit will operate the overload relay and disconnect the three poles of the switch The switch is mounted at the top of the pole as shown in Fig. 5, and it will be noted that the arrangement is such as to allow a very convenient arrangement for connecting to line and transformer terminals. Switch is controlled manually from the ground by two flexible cables operating a pulley wheel in the top of the switch case. There is an indicating dial on one side of the switch to show definitely when switch is open and closed. Disconnection lugs are placed on next adjoining pole. See Figs. 6, 10 and 11.

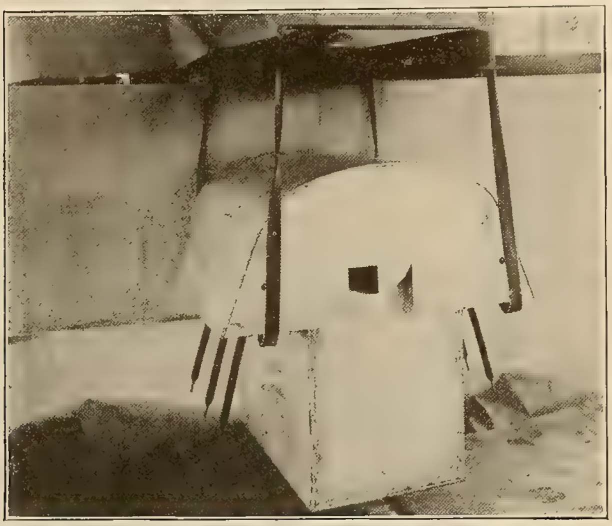


Fig. 4. Out-door Three-Phase Switch, Exterior View

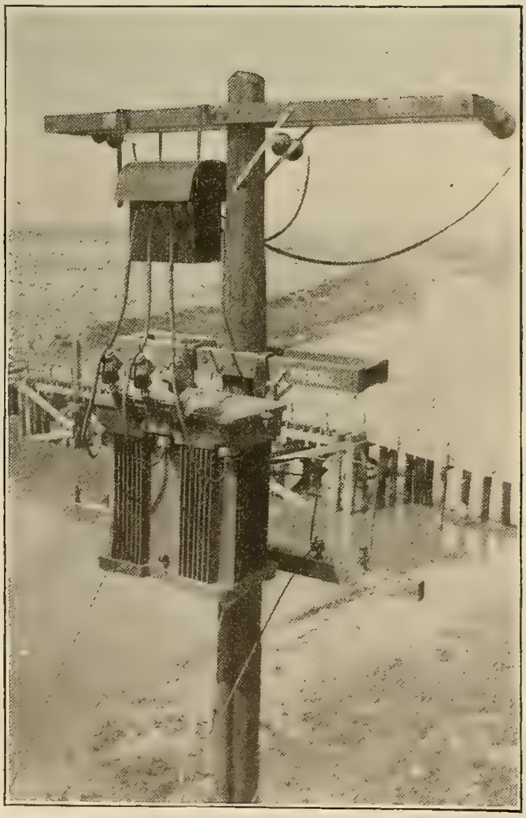


Fig. 5. Pole Mounting for Out-door Switch

We have had a number of these switches in operation in the past six months with entire success. The switch shown in Fig. 5 is within a mile of our Long Beach steam plant and connected directly to the 11,000 volt circuit, feeding from the generator bus bars with almost unlimited capacity in case of short circuit.

At this time we wish to report our experience with the use of three-phase, 11,000 volt distribution transformers. The use of three-phase transformers in large units for main station and substation installations has become a common practice, but three-phase transformers in small units for distribution purposes have not come into very general use in this part of the country. This no doubt is accounted for by the fact that a three-phase transformer can only be best used where strictly a power load or other balanced three-phase load is to be supplied.

Fig. 6. Disconnection Lugs and Handles for Their Operation

We have been installing three-phase 11,000 volt transformers for power service for the past two years and have 53 now in service. On account of the ease of installing and other advantages explained later, we have decided to standardize on their use as far as possible on all future installations for power supply in units from 10 to 100 kilowatts.

When it was decided to employ these three-phase transformers considerable study was given to the choice of winding to be used. We finally selected a design having a YY winding; certain taps were desired on the high tension side of the transformer as well as double voltage arrangement for the secondary side of the transformer, and the YY winding allowed these arrangements in the simplest manner. Shown in Fig. 7 is the arrangement of connections. The high ten-

sion winding is ungrounded while the neutral point of the secondary is grounded as a safety measure. The usual connection on the secondary coils is for a 460 volt service, although two secondary coils are provided on each leg of the transformer so that a 230 volt service can be obtained if desired. With a ground at the neutral point it is impossible to obtain a voltage in excess of 266 from any secondary line wire to ground.

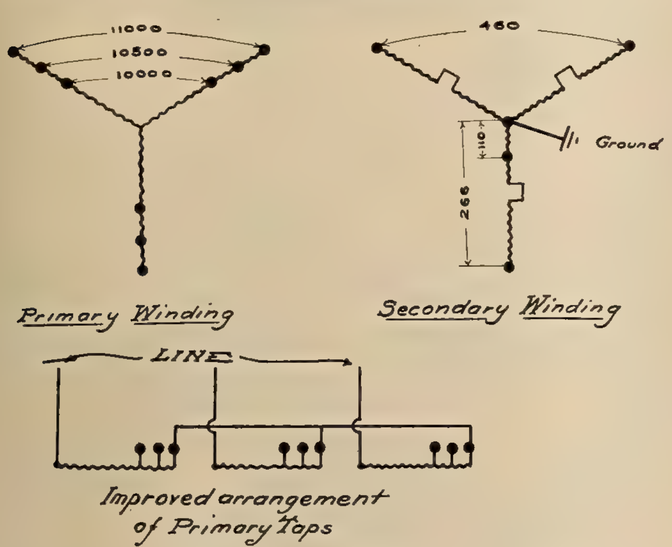


Fig. 7. Connections for Three-Phase Transformers

In most cases a few lights are required around the pumping plant and to furnish this service a tap is brought out from the winding on one leg of the transformer to supply 110 volts as between it and the ground connection.

We have had two cases of burn-outs with these three-phase transformers. In each case the burn-out was caused by an error in connecting the high tension winding, the transformer being allowed to operate with different taps, thus throwing unbalanced load on the secondary winding. In each case, however, the transformer operated for a number of months before breaking down. To avoid any possibility of wrong connections on the primary taps, we have arranged for future transformers to be delivered with the taps brought out on the neutral end of the windings as shown in the lower diagram of Fig. 7. With this arrangement it is impossible to obtain a wrong connection on the taps, as a common bar is used to connect the three taps.

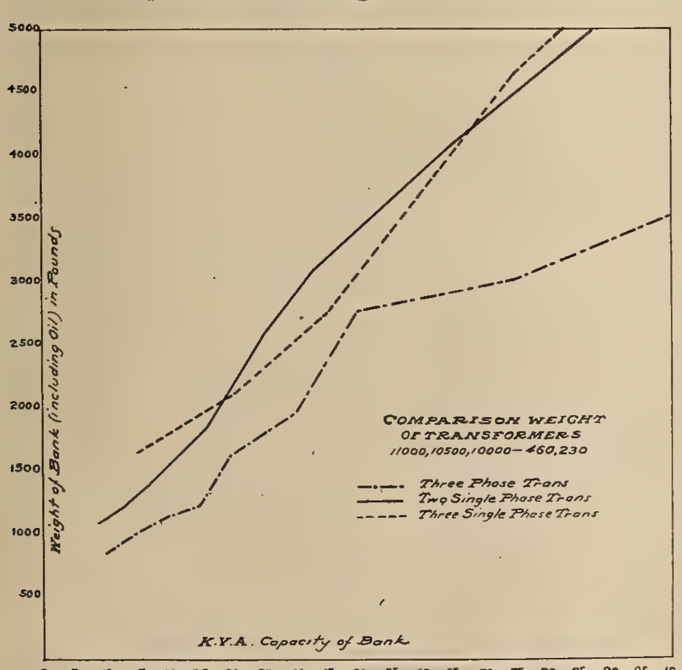


Fig. 8. Comparison of Weights of Three-Phase with Single-Phase Transformers

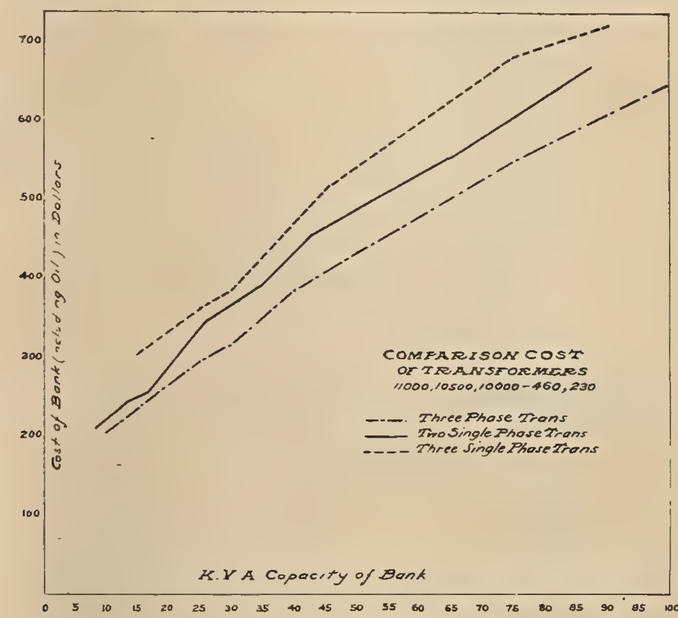


Fig. 9. Comparison of Cost of Three-Phase with Single-Phase Transformers

A comparison of the weights of three-phase transformers with two or three single-phase transformers for equivalent capacity is interesting. Such a comparison is shown by the curves of Fig. 8. The data for these curves is from General Electric transformers and include weight of oil. Correction has been made in case of two single-phase transformers to allow for the decreased capacity of the open delta connection. The saving in weight of transformers is worthy of consideration as it affects the cost of transportation and handling, as well as the strength of supporting pole to be provided.

Comparison of cost of three-phase transformer with equivalent capacity of two or three single-phase transformers is given by curves on Fig. 9. These costs are also for General Electric transformers and are 1916 prices and do not cover the recent increase which I understand has taken place in transformer prices. The cost of two single-phase transformers has been corrected to take care of the decreased capacity of the open delta connection. It will be noted that there is a considerable difference in costs in favor of the three-phase transformer and no doubt if other companies would adopt the use of these transformers so that they would come into more general production at the factory, the difference in cost would be further increased.

In Fig. 10 on the following page is illustrated the method of clamping the terminal to a 10,000 volt line, while Fig. 11 shows how the clamps and automatic oil switches are attached to the transmission lines.

NOTES ON SWITCHES AND FUSES

BY S. J. LISBERGER
Superintendent of Electrical Distribution
Pacific Gas & Electric Co

2300/4000 "Y" Connected Systems

Our experience with General Electric 104227 primary cutout and fuse on systems of the above voltage has been excellent, provided the device is not used on loads in excess of its rating, which is 30 amps.

We have had these plugs destroyed by severe short circuits, but the use of this device, taking into consideration its low cost, is generally satisfactory for the service above mentioned.

In the bay districts fog conditions at points have been so severe that it has been necessary to mount

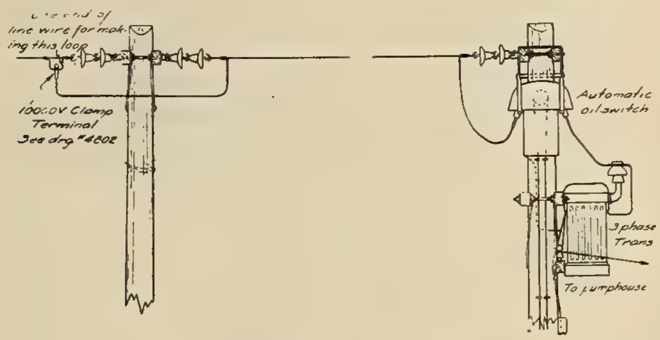


Fig. 10. Method of Clamping Terminal to 10,000 Volt Line

this on an insulator, as shown in Fig. 12. It might be of interest to note that we have used the safety plug puller as indicated on Fig. 13 very effectively on our system. By using this puller it is unnecessary for the man to put his hand anywhere near the fuse, either in inserting or pulling out the plug.

We have experienced more or less trouble with the fuses furnished for these cutouts in the smaller sizes. There appears to be a certain corrosive action between the composition fuse material and the screw terminals. We have been endeavoring to have the manufacturer build a fuse that would withstand this corrosive action. We have some of these fuses under test and the problem is apparently being solved.

The 100 amp. 2500 volt General Electric Cat. 5696 expulsion fuse has operated satisfactorily on our sys-

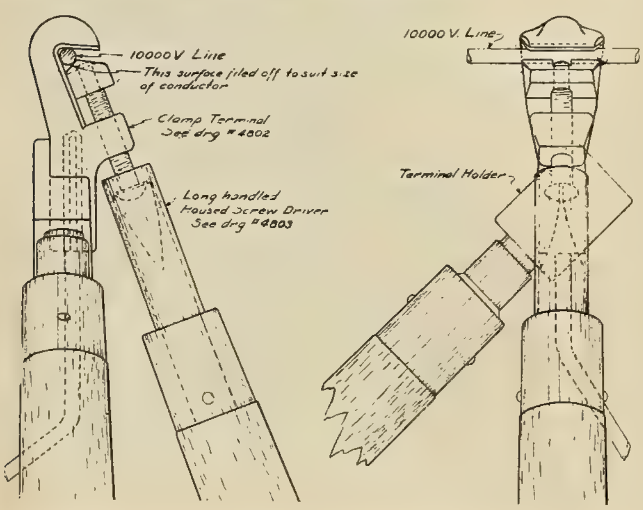


Fig. 11. Clamps and Automatic Oil Switches on Transmission Lines

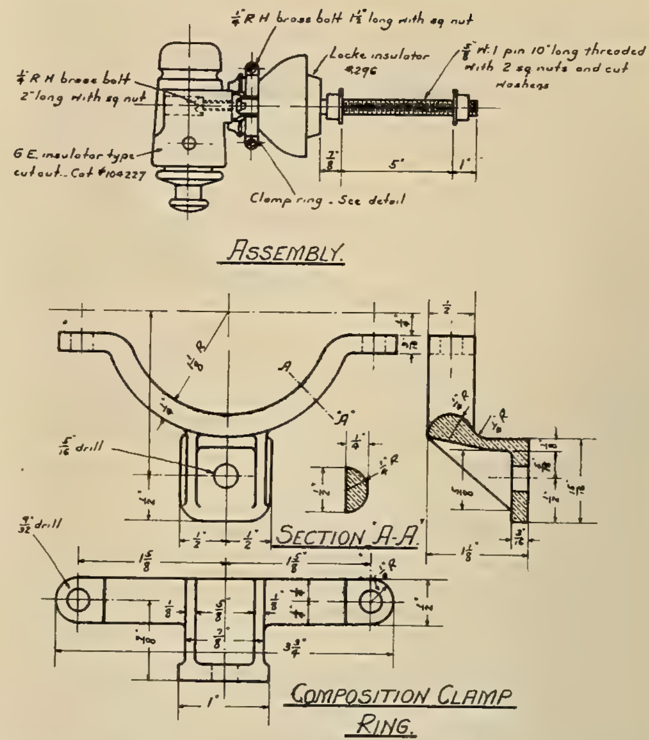


Fig. 12. Switch and Fuse Mountings in San Francisco Bay Region

tem where the amperage does not exceed 100, except in the districts in the immediate vicinity of San Francisco bay, where fog and dust is encountered. These cutouts are dangerous under this condition, as the fog and dirt collects inside the box so heavily as to ground the conductor to case.

Satisfactory operation of these away from the fog districts has been obtained, provided they have been limited to current, not to exceed 100 amps. This type of fuse, in my opinion, could be modified so as to make it a more effective device. The main faults are contacts not ample for the current and insufficient clearance between the fuse box and the iron cover.

We have tried many types of fuses and cutouts on this work but have not found anything more satisfactory than the above.

For sectionalizing branch lines we have used the D. & W. enclosed knife switch Catalogue No. 938, with marked success on 2300 volt systems. This is an excellent device for sectionalizing purposes, provided it is not necessary to operate the switch under load. Where it is necessary to operate switches under load we have used the G. E. pole type oil switch with excellent results and can recommend this to any one. It has been our practice to use pole type oil switches with a minimum rating of 200 amps. at 7500 volts on 2300 and 4000 volt lines.

6600/11000 Volt "Y" Connected Systems

Among the types submitted by the manufacturers for use on this service has been the wood box, similar to G. E. Cat. 44304 containing a porcelain base for

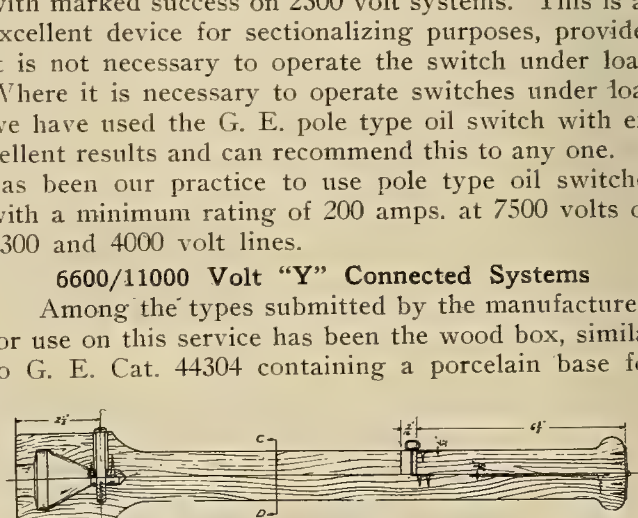


Fig. 13. Safety Plug Puller for San Francisco Bay Region

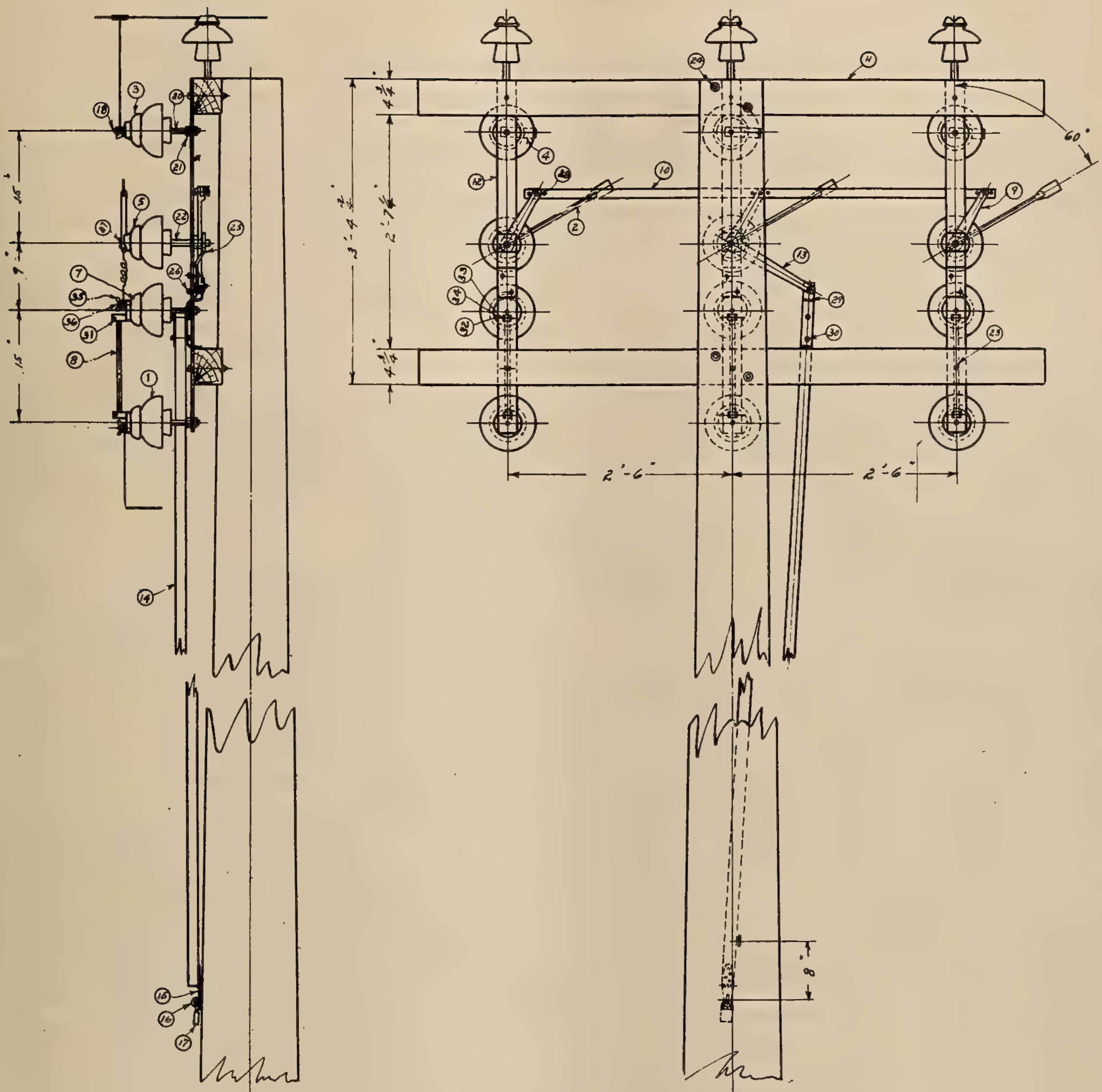


Fig. 14. Combined Switch and Fuse Developed by Pacific Gas & Electric Company

holding expulsion fuse. These boxes have hinged covers, insulating entrance bushings, etc. Our system has burned up every type of box presented and the accidents have been so severe that we have removed practically all of these boxes. Usually the box burns, setting fire to the crossarm and dropping the live wire to the ground.

I am opposed to any box, wood or iron, of this type, because it is customary to mount the fuse box above the transformer, and in order to disconnect or replace a fuse, the lineman must climb past hot wires in order to reach the fuse with a stick. In disconnecting the device it is necessary to open one fuse at a time, also our experience has been that the lineman usually forgets to carry the stick with him and attempts to operate the device by some more dangerous means.

Satisfactory operation under conditions prevailing in the West can be obtained by the use of a combined switch and fuse, similar to that shown on Fig. 14; this being a switch and fuse developed by the Pacific Gas & Electric Company and successfully used on its system.

The device consists of a combined disconnecting switch and fuse manually operated from the ground, enabling the lineman to climb the pole and replace a fuse without any hazard. It opens all three legs at once and thus does away with any hazard of a man ascending a pole to replace one fuse when the other two legs are hot. The device is simple in operation, inexpensive and has given satisfaction in the many hundreds of cases where it has been used.

The fuse consists of a wire encased in a glass or porcelain tube, held between two clips by means

of screw clamps. These in turn fit into the insulators, forming the support.

The switch and fuse mount directly on the cross-arm and pole supporting the line and transformers.

Our feeling is that this type of disconnecting switch and fuse is the only safe type to use on 11,000 volt work, irrespective of the details of design, as there may be other similar types on the market to do the same thing.

TRANSFORMER PROTECTION

BY C. O. POOLE

Chief Engineer, Southern Sierras Power Co

In reference to protection for transformers we have what we call a 33,000 volt distribution system in Riverside and San Bernardino counties. Our practice has been, up to the present time, to install banks of single-phase transformers, outdoor type, in the center of a section to be served, stepping down from 33,000 volts to 2300 volts; then running a network of 2300 volt lines to which are connected 2300 volt motors, 15 h.p. and over. In some cases we supply 440 volt motors by furnishing individual step-down transformers from 2300 to 440 volts, but measure the current on the 2300 volt side.

In our Nevada district we use 6600 volts for our general distribution system, stepping the voltage down from 6600 to 440 for motor service. In the Nevada district we have made general use of the standard cast iron Noark fuse boxes and they have proven quite satisfactory, but quite often one of these boxes is burned up, with consequent fire hazards, etc. We have used the pole type, oil disconnecting switches for switching our 6600 volt line in Nevada district, and these switches have proved very efficient and effective. Upon general principles, I am opposed to the use of fuses for this distribution work and my tendency is toward an oil circuit breaker for this purpose, both on the 6600 and 2300 volt systems. On our 2300 volt lines in the Southern district here we have been using the standard cast iron Noark fuse box type, and we have had cases of a single fuse blowing out and throwing our system single-phase with damage in several instances. This danger alone, in my estimation, is sufficient reason for abandoning the fuses in favor of three-pole circuit breakers, to say nothing of other advantages that would be gained thereby.

For an ordinary bank of transformers,—we use a set of 3-100 kw. transformers,—the cost of a circuit breaker would be about $60 as against $20 for a set of Noark boxes with fuses. These fuses, as you are aware, blow out quite frequently and if several of them blow out during the season the expense would easily justify the difference in cost in favor of the circuit breakers. It is our practice at this time to install circuit breakers in preference to the fuses on our larger size of transformer banks. It is my recommendation that this practice be pursued and hope that the manufacturers will be able to produce a less expensive circuit breaker to serve the purpose for smaller installations.

In connection with the subject, it might be of interest to know that we are now endeavoring to standardize our rural practice by utilizing three-phase transformers, stepping down direct from 33,000 to 440 volts, with a view of gradually replacing our 2300 volt systems as circumstances will warrant. This practice presents another difficult problem in the matter of fuse protection for this type of installation and inasmuch as oil circuit breakers for this voltage are very expensive, it is our practice to install a combination air break switch and a tube covered fuse. We have used quite a number of the liquid fuses and, while they have been fairly satisfactory, yet the replacement of them in case of blow outs is very expensive.

FUSE PRACTICE ON OVERHEAD LINES

BY JOHN A. KOONTZ

Electrical Engineer, Great Western Power Co

Fuse practice on the overhead lines of the Southern California Edison Company, in particular that for the protection of transformers on the 2200, 4000, 11000 and 22000 volt distribution circuits, is briefly noted in this article. The fuse holders used for the various types of service are as follows:

Voltage	Amperes	Type of fuse holder
2200	1- 25	G. E. Primary cut-out cat. No. 104227.
2200	30-100	G. E. Primary cut-out cat. No. 5696.
4000	1- 25	G. E. Primary cut out when portecting a 2200 volt transformer cat. No. 104227.
4000	30-100	G. E. Primary cut-out when protecting a 2200 volt transformer cat. No. 5696.
4000	25-100	For secondaries of 22000 volt transformers,
-		4000 volt lines Pacific Electric No. 1013.
6600	3- 50	Pacific Electric No. 1035.
11000	3- 50	Pacific Electric No. 1035.
22000	3- 30	Pacific Electric No. 1035

We gave the Pacific Electric fuse a severe test in regard to rupturing capacity before using them on our lines. These fuses have given good satisfaction as far as clearing trouble is concerned. The only fault we have to find with them is in regard to fuse tubes burning, particularly when fused with small size aluminum wire, the fuse wire corroding and opening with time. This trouble has been largely removed by using a General Electric alloy fuse wire on the smaller ampere sizes, but I feel that this General Electric alloy wire will be satisfactory up to at least 20 ampere sizes. I would want to see the larger sizes tested before recommending them as the explosive action of the wire when fused might be sufficient to cause trouble. Aluminum wire is particularly good, in that it can be oxidized with a small amount of explosive violence. We have been looking the market over for a fuse tube that would have the mechanical and dielectric strength of micarta or bakelite, and still be fire-proof. If we could obtain such a material, we feel the fuse situation would be practically solved.

Regarding the action of these fuses on heavy loads on 22,000 volt circuits, we have noted numerous cases in which banks of 3-400 k.v.a. transformers have been cleared when protected by 60 ampere fuses. These fuses have not only cleared local trouble on the bank, but did it without tripping the automatic breakers at the substation.

On our 11,000 volt feeder work, especially on the heavier loads, we have used in many cases a combined fuse and disconnecting switch of our own make. The fuse portion consists of an 18 in. hollow wooden tube which is fused with small copper wire. This arrangement will not give over-load protection to the apparatus, but will clear the feeders in case of defective

transformers. When protecting banks of 3-50 kw. transformers or larger, the tubes are in general thrown out of the holders, and quite often broken, but this does not interrupt the feeder, and the matter of replacing a new fuse tube is inexpensive.

Our practice is to fuse transformers at approximately double normal current, and in order to eliminate trouble from using improper size fuses, we have made up rather complete tables covering the fuse size for all standard transformers, banks and connections. For example in case we were handling a bank of 3-2200 volt 25 kw. transformers, if these three transformers were connected in "delta" on a 2200 volt line, they would be fused with 40 ampere fuses, while if the same transformers were connected in "Y" on a 4000 volt line, 25 ampere fuses would be used, and if a single transformer was connected for lighting work; 25 ampere fuses would be used, or this same size would be used if two transformers were connected in "T" or open "delta." These tables were made up to prevent a certain amount of confusion on the part of field men, and they have been found very satisfactory.

The fuse problem, as it appears to me, is one of obtaining a mechanically rugged, inexpensive and fireproof fuse holder that can be fused with small capacity wire, and used on 11,000, 15,000, 17,000, 22,000, and 33,000 volt circuits.

FUSE PROTECTION ON 2300 AND 11000 VOLT SYSTEMS

BY L. M. KLAUBER

Superintendent Electrical Department, San Diego Consolidated Gas & Electric Co

Notes on the practice of the San Diego Gas & Electric Company with reference to fuse protection of transformers and branch lines in rural distribution systems of 2300 to 11000 volts are herewith submitted.

On our 2300 volt systems (which are three-phase with neutral ungrounded) we use no fuses on branch lines. At transformer stations requiring fuses of 30 amperes capacity or less, we use General Electric porcelain plug cut-out, Catalogue No. 104227. For transformer installations requiring fuses in excess of 30 amperes we use General Electric 100 ampere 2500 volt cut-out box No. 159327 with expulsion fuse holder No. 159330[1].

The above protective devices are giving us good satisfaction. We ordinarily fuse transformers for approximately double load; that is, a fuse is chosen having an amperage approximately twice the full load primary current of the transformers. On 11000 volt service we fuse transformer stations with General Electric cut-out boxes, Catalog No. 123340, with expulsion fuse holders No. 123341. This is a box rated at 10

[1]The General Electric Company, in order to consolidate various types, may abandon Catalog No. 159327, substituting therefor 6600 volt 100 ampere cut-out box No. 106918, with fuse holder No. 106902. Upon this point they have not yet advised us definitely.

Fuse Sizes for Three Phase Delta Connected Transformer Banks

Size KW.	110	Cat. No.	220	Cat. No.	44	Cat. No.	2200	Cat. No.	6600 G.E. alloys	11000 Fuse	22000 Wire
					Volts						
1	25	51277	15	Wire	10	Wire	2	23175	3		
1.5	40	51279	20	Wire	10	Wire	3	23176	3		
2	50	51280	25	51277	15	Wire	3	23176	3		
2.5	60	51281	30	51278	20	Wire	5	23178	3	3	
3	75	51283	40	51279	20	Wire	5	23178	3		
4	100	66435	50	51280	25	51277	5	23178	3		
5	130	66441	60	51281	30	51278	10	23179	3	3	3
7.5	190	66453	100	66435	50	51280	10	23179	3	3	
10	250	66465	130	66441	60	51281	15	23180	5	3	3
15	380	66495	190	66453	100	66435	25	23182	10	5	3
20	500	66527	250	66465	130	66441	30	9425	10	5	3
25	600		320	66479	160	66447	40	9426	15	10	5
30	600		380	66495	190	66453	50	9427	15	10	5
40	1000		500	66527	250	66465	60	23157	20	10	5
50	1200		600		320	66479	75	9428	25	15	10
75			1000		470	66521	100	9429	40	25	10
100			1200		600		125		50	30	15
150											25

Fuse Size for Open Delta Connected Transformers, Star Connected Transformers, "T" Connected Transformers, Single Phase Transformers

Size KW.	110	Cat. No.	220	Cat. No.	44	Cat. No.	2200	Cat. No.	6600 G.E. alloys	11000 Fuse	22000 Wire
					Volts						
1	20	Wire	10	Wire	5	Wire	1	23174	3		
1.5	20	Wire	15	Wire	10	Wire	1	23174	3		
2	30	51278	20	Wire	10	Wire	2	23175	3		
2.5	40	51279	25	51277	10	Wire	2	23175	3	3	
3	40	51279	25	51277	15	Wire	3	23176	3		
4	60	51281	30	51278	20	Wire	3	23176	3		
5	75	51283	40	51279	25	51277	5.	23178	3	3	3
7.5	100	66435	60	51281	30	51278	5	23178	3	3	
10	150	66445	75	51283	40	51279	10	23179	3	3	3
15	220	66459	100	66435	60	51281	15	23180	5	3	3
20	290	66473	150	66445	75	51283	20	23181	5	3	3
25	360	66487	180	66451	90	51285	25	23182	10	5	3
30	440	66515	220	66459	100	66435	30	9425	10	5	3
40	600		290	66473	150	66445	40	9426	15	10	5
50	700		360	66487	180	66451	50	9427	15	10	5
75	1000		550		270	66469	70	23158	25	15	10
100			700		360	66487	90	23160	30	20	10
150							125		50	30	15
200											20
250											25
300											30

Notes.—Above catalogue numbers are General Electric.

Above wire figures are ampere ratings of fuse wire.

Use 2200 volt fuses on this table for Star banks on 4000 v. Use 6600 volt fuses on this table for Star banks on 11000 v.

For fusing 110, 220 and 440 volt circuits, General E'ectric secondary cutout No. 67275, with proper size wire or fuse, shail be used.

For fusing 2200 and 2400 volt circuits, 1 to 25 ampere capacity, inclusive, General Electric primary cutout No. 104227 shall be used, with proper size General Electric fuse. 30 to 100 ampere capacity shall be protected with General Electric fuse box No. 5696, with proper size fuses.

amperes and 15000 volts, but we use it up to 20 amperes at 11000 volts. We found the boxes as put out by the manufacturers inadequate to our service; consequently we purchase the fittings and make up in our own shops, heavy poplar boxes to contain them. Transformers are ordinarily fused from 50 to 75 per cent overload. As a matter of fact these fuses, like all other fuses of this type, give little protection against overloads, but give fair protection against short circuits. Where a branch line is installed to serve a single customer these fuses are usually located at a point where the branch is tapped to the main line, rather than at the transformer.

For the protection of the longer branch lines we are installing Pacific Electric switch No. 1420-F. We find that these give good protection except that the cartridges almost invariably burn up when the fuse blows. In one of our districts, in the place of General Electric cut-out boxes for transformer fuses, we are using Pacific Electric switch No. 427-F mounted vertically. These take the same uses as No. 1420-F. They appear to give good service and have the advantage over the cut-out boxes that the entire installation can be killed by means of an extended operating rod before the troubleman begins to climb the pole, consequently it is not always necessary to send out two men when a fuse is to be renewed.

We are using three-phase transformers on suburban 11000 volt lines in the place of former open delta banks and find them greatly to be preferred to single-phase transformers, in that they reduce the cost of installations and the hazard due to the simplicity of the wiring on the pole.

Like all other companies we have from time to time been bothered by single fuses blowing on three-phase lines, thus leaving various small motors running single-phase until they burned out. We have looked the market over for 11000 volt automatic oil switches for out-door service, but have not been able to locate anything. We have been informed that the Pacific Electric Manufacturing Company has now in process of development and almost ready for the market, a combination oil and air break switch with which you are familiar. This may solve our difficulties on the larger 11000 volt transformer stations, but on stations of 300 k.v.a. and over we have found fuses very unsatisfactory. We are also trying out a Bowie automatic air break switch on a 600 k.v.a. station, but this has not been installed long enough to give us an indication as to whether it will be satisfactory.

FUSE PROTECTION ON DISTRIBUTING LINES

BY E. A. QUINN
General Superintendent, San Joaquin
Light & Power Corporation

The 10 kv. feeders from substations of the San Joaquin Light & Power Corporation are protected by a 3-pole General Electric K-12 automatic oil circuit breaker connected into circuit through three series transformers. All branch lines are taken off the main feeder through a 3-pole single disc K.P.F. pole top air switch. All taps to transformers are protected through three "disconnects," made at the company shop, the use of which over an experience covering several years has proven very satisfactory.

An illustration showing the essential features of these disconnects is attached hereto. It will be noted that on the cross-bar holding the fuse is attached, in the center, a standard 10 kv. insulator. The cross-bar is removed from the clips, for re-fusing or disconnecting, by means of a five foot stick threaded on the end, which is screwed into the insulator. The operator does not come at all close to live parts. There are in service in this company approximately 15,000 of these disconnects, and very little trouble has been experienced from them. About the only trouble experienced is the burning of the cross-bar during wet weather, when the fuse has blown. However, this percentage is small. The total number of cases of this nature during a season is well under 30.

We are now experimenting to find a material which will not burn, although wet with the fuse out. One objection to the use of the "disconnect" is the fact that one leg of the circuit is opened, and not all three legs together. The cost of three of these disconnects f.o.b. our storeroom is $5.78.

We install at intervals of two or three miles, or at some convenient point, an air break K.P.F. switch, and as almost all our circuits are of the "loop" type we can cut out a short section of line in case of trouble without serious interruption to the whole line.

On our 2300 volt distribution all circuits are protected by automatic oil circuit breakers at the substation. Pole top oil switches are used for sectionalizing the line. All transformers are protected by General Electric plug cut outs. Our fusing table for 2300 volt transformers is as follows:

k.v.a.	Fuse Amp.	k.v.a.	Fuse Amp.	k.v.a.	Fuse Amp.
1	1	7½	5	30	20
2	1	10	6	37½	25
3	2	15	10	40	30
4	2	20	15	50	30
5	3	25	15		

We have considered various makes of three--pole fuses, or a combination switch and fuse, but the expense of these is so great in comparison to the 6600 volt disconnects which we are using that we have decided to continue the use of our own disconnect.

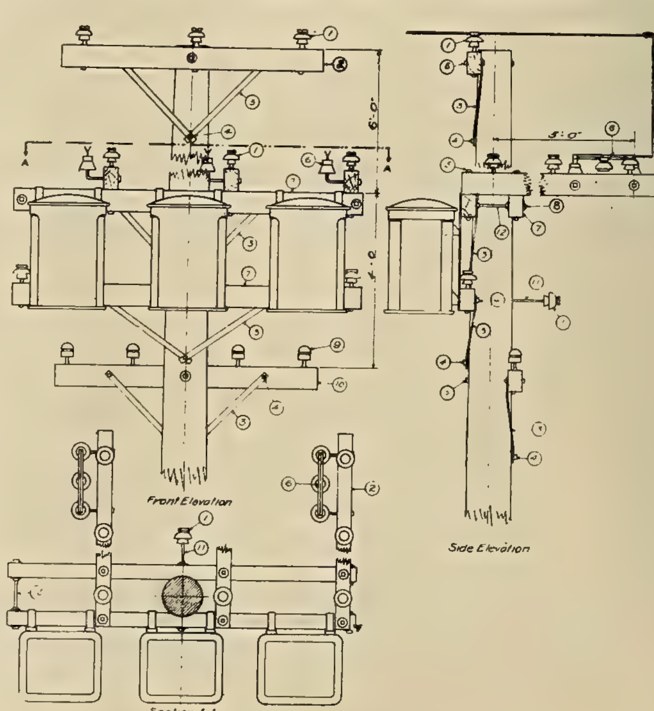


Fig. 15. Suburban Transformer Structure on Transmission Line Pole

STANDARDIZATION OF THE HARDWARE FOR CLEVIS CAP SUSPENSION INSULATORS

BY L. M. KLAUBER

Superintendent Electric Distribution, San Diego Consolidated Gas & Electric Co

Scope.—This report has for its purpose a consideration of the dimensional standardization of the hardware of clevis cap suspension insulators. Insulators having hook caps, eye caps or various patented methods of linking, will not be considered, nor will the respective merits of these several types be discussed.

Necessity for Standardization.—The clevis cap strain insulator as a unit has become a standard appliance in line construction practice. Not only is it used extensively in the construction of transmission lines, but it plays an important part in the installation of high voltage transformers, lightning arresters and switch gear at generating and substations. Many auxiliary fittings, such as tower links, suspension clamps, strain clamps and strain yokes have been placed on the market especially for facilitating the use of these insulators. It is obvious that standardization is essential in order that units may be interchangeable and that supporting links and fittings may be used with any line of clevis cap insulators.

In the past there has been a wide variation, not only in such details as the width and depth of clevis, but in such essential elements as the diameter of the bolt and the hole in the stud. Often the styles of a single manufacturer have not been similar or interchangeable. In consequence, many operating companies, having once adopted a unit with auxiliary hardware, have been prevented from taking full advantage of improvements in type, or have been required to district their systems, carrying separate lines of renewal parts for each district or transmission line.

In order to indicate the non-interchangeability of present types, we present herewith Table I:

Table I

	A 1	A 2	A 3	B 1	B 2	C 1	C 2
A 1	Yes	No	No	No	No	Yes	No
A 2	Yes	Yes	Yes	No	Yes	Yes	No
A 3	Yes	Yes	Yes	No	Yes	Yes	No
B 1	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B 2	Yes	Yes	No	No	Yes	Yes	No
C 1	Yes	Yes	No	No	Yes	Yes	No
C 2	Yes	Yes	Yes	Yes	Yes	Yes	Yes

In deducing this table we have taken at random two or three standard styles of insulators manufactured by each of three companies. These have been given type numbers, A 1, A 2, etc.; similar letters indicating the product of a single manufacturer. We have endeavored to fit these insulators together in pairs in all possible combinations, with the result shown in the table. In reading the table it should be noted that in any combination the insulator in the top row was placed above that indicated at the left; that is, the stud of the insulator in the top row was connected to the clevis of that in the vertical column. It will be noted that connections could not be made in 15 out of 49, or 30.6 per cent of the combinations. Several of the combinations which have been considered possible, were made with such difficulty that they would not be feasible for field work.

Present Status of Standardization.—On November 27, 1916, representatives of three of the insulator manufacturers met in New York with representatives of one of the largest of the engineering and operating companies and determined upon a manufacturers' standard clevis type connection for suspension insulators. Through the courtesy of the officials who attended the conference we have been furnished with the details of the standard agreed upon, as shown herewith in Fig. 1.

It was at first thought that this conference and the standard agreed upon would obviate the necessity for further deliberations by your committee. However, after a study of the new standard, its interchangeability with older designs, and its use with existing hardware and fittings, it has been deemed advisable to bring the matter before this meeting for discussion.

The following quotation from a letter from one of the operating engineers who attended the conference will explain the scope of the adopted standard:

"In view of this great variety of clevises which previously have been put out, it will be appreciated that it was entirely futile to attempt to provide a clevis which would be fully interchangeable with the entire lot, although it happens that it will be possible to make replacements by shifting all of the old units to one end or the other of the insulator string as may be required. The manufacturers have agreed with us that the form and dimensions shown would seem to be the most satisfactory that can be arrived at from the standpoints of weight, strength and reasonable interchangeability with the older forms.

"Consideration was given to the developing of a clevis along the lines of considerably greater strength, so that it would be suitable for practically all uses, but it was decided that the demand for high strength insulators was not sufficient to justify the increase in weight and dimensions in hardware for the 10 in. disc insulator as ordinarily used. It is pretty fairly agreed that they should not be used for loads exceeding 3000 pounds. The standardization of a large clevis for heavy duty insulators may prove to be advisable, and the manufacturers mentioned have this possibility in mind."

Of primary importance in connection with this new standard is the adoption of the ½ in. bolt. While it is a fact that this bolt has a strength exceeding that of the porcelain of the insulator and is subject to little wear or corrosion, nevertheless the adoption of this standard has rendered the new unit less interchangeable with the older designs, a majority of which were equipped with ⅝ in. bolts. The new standard is substantially the same as the type referred to as B 1 in Table I. (B 1 and C 2 are the only types having ½ in. bolts, the rest having ⅝ in.). It will be noted that owing to the 9/16 in. hole in the stud, B 1 will fit above B 1 and C 2 only, although it will fit below all. To fit one of the new standard insulators into an old string having ⅝ in. bolts, the new member must either be placed at the bottom of the string or the pin of the next lower number must be changed to ½ in., which effects a rather loose connection. Even if placed at the bottom of the string it will be necessary to replace the bolt of the suspension or strain clamp with ½ in. bolt unless already so equipped.

But a matter which cannot be so easily remedied is the condition at the tower end of the string. Obviously, if the ring, stud or punched member at the tower has a thickness in excess of 9/16 in. the new standard insulator cannot be attached without the interposition of an S-hook, or other connecting link, and in future ⅝ in. eyebolts must be replaced by ½ in.; for not only are the clevis wings on the new stand-

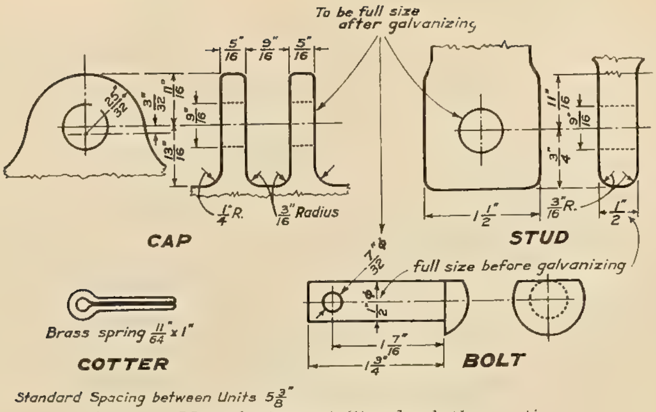


Fig. 1. Manufacturers' Standard Connection for Suspension Clevis Type Insulator

ard too close together to permit the entrance of a ⅝ in. eye, but the depth of clevis below the bolt is too shallow for a ⅝ in. part. This is of especial importance where the insulator is attached directly to a punched member, since great accuracy will be required in spacing the hole correctly from the end of the member.

Suspension insulators of this type are constantly growing in favor for use in high voltage distribution work (6600-33000 volts) at deadends and at corners. In wood pole lines of this nature the ⅝ in. bolt is largely standard for through bolts, space bolts, etc. It has been the practice with most companies to use ⅝ in. eye bolts, U-bolts or eye nuts in this work for the attachment of strain insulators and with the new standard this will no longer be possible. Furthermore, in work of this type the strain clamp is usually omitted, the line wire being attached directly to the stud of the insulator protected by a thimble. With 9/16 in. hole a ⅜ in. thimble is the largest which may be used, and this will tend to cramp the larger conductors.

In view of these facts it is questionable whether the choice of the ½ in. bolt and the limitation of the use of the clevis to ½ in. line hardware is justified. A fitting base on ⅝ in. hardware is interchangeable with ½ in. insulators or fittings (if the ⅝ in. bolt be replaced with a ½ in.) so that such an insulator can be used at any point where a ½ in. base can be used and in many cases where it cannot. Thus while the ½ in. bolt is justified on the score of strength and first cost, it is not so desirable on the score of interchangeability, and the latter should, we believe, receive first consideration.

Whatever the ultimate decision in regard to the size of bolt, the distance from the lower edge of the

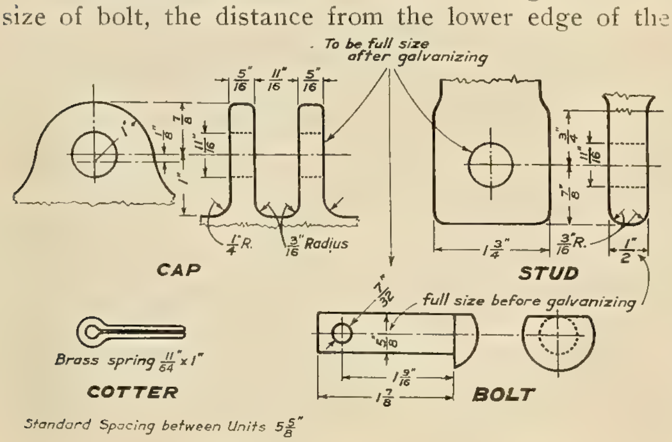


Fig. 2. Suggested Standard with ⅝-in. Bolt

hole to the bottom of the clevis (17/32 in.) is open to question. This should be made 1/16 in. greater to permit of variations, not so much in adjacent insulator studs, but in tower supporting links. The square edge of the stud would still be sufficient to prevent porcelain parts of adjacent units from striking when being hoisted into place or when swinging in service, which is all that is required. The increase in total length of unit will be unimportant. It would be inadvisable to correspondingly increase the distance from the lower edge of the hole to the bottom of the stud, as this would frequently render impossible, interchangeability with existing units.

Alternative Standard.—With these facts in mind we offer for discussion an alternative design, having a ⅝ in. bolt as a basis. This is shown in Fig. 2. Such

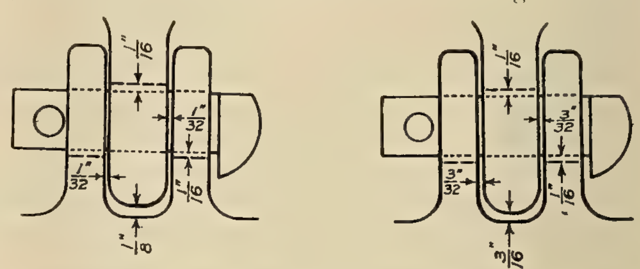


Fig. 3. Comparative Clearances of Manufacturers and Suggested Standards

a design might either be adopted as a universal standard, or as a standard for high strength units. We likewise show in Fig. 3 comparative side views of the adopted ½ in. standard and the suggested ⅝ in. standard to show clearances.

SOME NOTES CONCERNING THE JOINT USE OF POLES

BY J. E. MACDONALD

Secretary, Joint Pole Committee, Los Angeles, Cal

Essentials of Agreement.—The function of a joint pole agreement is to provide a method whereby the number of poles occupying streets, highways, and other public places may be reduced to a minimum. With no other obligation than "to play the game on the square," the Los Angeles public service corporations have been operating under such an agreement for over ten years, during which time approximately 80,000 poles have been involved by its terms and conditions. The collaborators only knew the results which it was desired to accomplish by the agreement and "intent and purpose," rather than "ways and means," constitute its dominating features. It was the intent and purpose to eliminate all superfluous poles as soon as practicable, yet there was no suggestion in the agreement that joint construction should be obligatory in any case. To make joint construction mandatory by agreement, would in effect be the same as a self-imposed ordinance requiring the reconstruction of overhead lines regardless of the merits of each case. Briefly stated, an agreement should set forth in detail its purpose, specify certain rates for joint use, and formulate general rules governing equitable adjustments for all cases of construction and reconstruction which are likely to arise in prac-

tice. The administration of the agreement, manner of making repairs, renewals, reconstruction, or changes in location of joint poles, limitation of attachments, maintenance of wires and cables, termination of joint ownership, salvage, rights of way, taxation, and liability are all important items which should be fully covered to conform to the requirements of local conditions. A general specification covering joint construction methods is desirable. Such specification must not conflict with any legal requirements of state or municipal authorities.

Application of Agreement.—Various methods may be adopted for making the agreement effective. Matters involving joint poles may be handled through routine channels by regular employes of the utilities affected. Where a large territory is to be covered and where there are several utilities involved, a better method is to appoint a committee, consisting of one representative from each utility. This committee should elect a secretary, who may be one of its own members and act without salary, or if the project be sufficiently large, he may be an independent employe not otherwise affiliated with any of the utilities. The duties of a committee include all preliminary arrangements for joint construction and the preparation of records in connection therewith. Any utility desiring to make a change in its pole plant, notifies the committee of its intention so to do. The committee proceeds to find out if any other utility is affected and desires to be provided for, making the necessary plans and arrangements accordingly.

Charges for Joint Use.—The joint use of poles involves the buying, selling, leasing or renting of pole facilities. Charges for joint use are usually based on the valuation of the pole set, painted and stepped, ready for installation of crossarms, wires, cables and other appurtenances. These charges may be made on the basis of joint ownership, joint use under perpetual easement, life rental, annual rental, or contact rental. As standardization is desirable, it is inadvisable to permit of an indiscriminate choice of method under one agreement. The joint ownership basis is a very effective method, which provides for the sale or purchase of an undivided share or interest in poles. This method has the slight disadvantage of requiring great detail in making appraisals for rate making or taxation purposes. Joint use either by perpetual easement or life rental is free from this disadvantage, and if rates are developed to include the proper proportion of the fixed charges, either method may obviate the necessity for much inter-company billing, such as exists under the joint ownership method. On the other hand, it is impossible to make these charges absolutely equitable. A rate which is effective for two companies is excessive on the advent of a third party, and it seems impracticable to provide for refunding on rentals owing to the endless detail which this would involve. Charges on the annual basis are open to the same objections and in addition involve an annual check which is expensive where more than two companies are concerned. A contact rental is not applicable to a general joint pole scheme, but furnishes a convenient method for a limited number of contacts in special cases. These rates should be sufficiently high to discourage their general use. All conditions considered, the joint ownership basis represents the most effective method. With the proper unit record of poles the objections to this method are negligible.

Records.—Common practice in recording joint poles comprises the preparation of a map and schedule supplementing the working agreement. Each of these supplements in itself is a contract and is executed by the parties interested. Continuous use of this system has developed its weak points and it is no longer recommended where more than two utilities are operating. It is believed that a pole is just as important a part of the plant as a meter, transformer, telephone or other piece of equipment. As such it should be considered as a unit. Each pole—joint or otherwise—should be numbered and initialled, the initial signifying original ownership. All reference to any pole should include its number and initial. Each utility should have its own complete series of numbers. In the event that it is necessary to handle recording work through a regularly organized committee, the following method has been found fairly adequate. Applications for joint use are made by pole number on regular forms provided for the purpose. If one or more of the poles applied for is already a joint pole, the previous record discloses this fact and the committee makes the segregation, referring the application to the proper parties. If the pole or poles are not of record, copies of the application are forwarded to the owning party, which furnishes complete recording data in approving the application. This eliminates the necessity for a field check on the part of the committee. Authorization for billing is covered by a bill of sale. These are issued monthly in accordance with applications which have been duly approved for the various interests involved. A card index for each pole is prepared, two copies of which are furnished each party to the transaction. One set of the cards is for consecutive file and the other is for filing according to location. The information necessary for recording is as follows. Pole Number, Location, Length, Year Set (New or Second-hand), Condition (as to Painting, Stepping, or Treating), and the joint users, with their equities and circuits. Each card contains this information together with reference to bill of sale; the basis of settlement, and the application number of the utility purchasing interest. The cards are prepared and multigraphed prior to the preparation of the bill of sale and forwarded to the interested parties for checking. Cards for subsequent transactions involving the same pole, show all preceding transactions and constitute a true and complete record. Under the unit system, billing is authorized in all cases within thirty days after the approval of an application.

Under the supplement method of recording, it is difficult to maintain a true record at all times owing to the continual changes which are taking place in ownership and replacements, which are being made from time to time. Further, the time taken to obtain the signatures of all parties to the combination is excessive. As individual replacements take place, the record is continually approximating the unit system and it therefore seems desirable to adopt this system in the initial stages of joint construction. If it ever

becomes necessary to change systems the task may be extremely onerous. When it was decided to adopt the unit system in Los Angeles there existed 14,511 supplements, which are being worked over to conform to the more modern system.

Expense.—The cost of recording must necessarily depend upon the volume of transactions. Based on average monthly transactions involving 300 poles, the cost of recording may amount to $1.25 per pole, and may not justify the existence of a committee. For average monthly transactions involving 2000 poles, the recording cost by committee should not exceed 50c per pole. In Los Angeles, the expense is pro-rated against member companies. Utilities which are not parties to the general agreement are frequently permitted to participate in joint construction and are charged 15 per cent of their equity in combinations recorded. The amount so collected is deducted from the total expense of the committee before pro-rating. This method is not essentially correct. It has been proposed that the utilities be divided in two classes—members and non-members, or members and associate members. Member companies should be assessed a fixed monthly sum and associate members should be charged a percentage of their equities in combinations recorded as heretofore. Any expense in excess of the sum derived from the fixed monthly assessments and the collections from associate members should be pro-rated against member companies in proportion to the monthly transactions involving these companies.

Results.—There are certain intangible benefits to be derived from joint construction which cannot be estimated. In 1908, the property owners on a certain street got together and demanded underground subways for all public utilities. The municipal authorities were favorable to the project and an ordinance creating the underground district was prepared. The committee became active and obtained an agreement with a majority of the property owners, agreeing to the maintenance of one joint line on each side of the street for a period of at least five years, provided that joint constructon was immediately undertaken. The proposed underground covered a distance of 9300 ft. and involved five utilities. It was possible to accomplish the reconstruction without setting any new poles, and over 300 superfluous poles were removed from this section. The property owners were so well satisfied that the underground project has been entirely forgotten, although almost nine years have passed since the signing of the agreement and part of the street is in the remote business district where underground may again become an issue at any time. A more significant result is found in the direct economies effected when two, three or four utilities occupy the same pole, dividing the investment cost and also fixed charges which amount to at least 19 per cent of the pole value annually. Another important benefit arises through the legal requirement for overhead construction, which makes it extremely difficult to comply with such regulations except through a joint use of poles. Taken therefore as an operating condition, the joint pole should be considered as an economic necessity rather than a choice of the lesser of two evils; an involuntary choice sometimes between overhead and underground construction.

Special Problems.—A large part of all combinations are effected on existing poles. Such combinations are made in a routine manner and present no unusual conditions for consideration. A small percentage presents no greater problem than the preparation of plans for the approval of the utilities affected, where it is proposed to make extensions into undeveloped territory, or to reconstruct on account of public improvements (the opening and widening of streets and changing of grades), or to reconstruct on joint poles to offset the demand for underground conduit and subways where assurance can be given that a joint pole line will be acceptable for a reasonable term of years. A small percentage involves special problems in equity, which can only be adjudicated in conference and compromise by the utilities concerned. These involve locations occupied by two or more utilities where reconstruction becomes imperative for one of them but not for the others. The existing construction of one or more of the utilities occupying this location may be entirely adequate and in first-class shape, or it may be partially or almost wholly obsolete. Certain general rules may be formulated governing such conditions, but no rule will fit all conditions which are likely to arise in practice. In general, the party through whose necessities reconstruction becomes necessary, should not be instrumental in making the conditions any more objectionable after reconstruction than before. If a joint lead of recent construction is overbuilt, it is incumbent upon the constructing party to make whatever concessions are necessary to continue the highly improved condition. On the other hand, if overbuilding the leads of one or more parties whose poles, wires, and fixtures are apparently inadequate and obsolete, the constructing party should not be called upon to make any concessions other than to set poles sufficient for the joint use of all parties occupying this location and such parties should purchase interest or easement in the usual manner. Between these extremes there are many conditions requiring special consideration. Mutuality of interest will bring about a solution in nearly every case. It is only during a period of general retrenchment that these conditions are not likely to obtain.

Suggested Developments.—In line with the development of the joint use of poles it is apparent that the possibility exists for further co-operative effort. The time is not far distant when over half of all poles will be occupied jointly. With the present day tendency toward concentration it would be a desirable undertaking for the pole using utilities to have their entire pole record centralized. This possibility was given consideration when the unit system was adopted and pole report forms are in use for joint poles which, if adopted universally, would bring about the result proposed without any abnormal demands upon the operating companies. If it is desirable at all times to have a correct valuation of the pole plant, such a method offers an easy solution.

PROCEDURE FOR HIGHWAY LIGHTING DISTRICTS

BY E. B. WALTHALL

(The ever increasing usefulness of the beautiful highways of the West is daily bringing about a civic pride in the manner of illumination. Hitherto in unincorporated towns and villages no legal procedure has been available whereby lighting districts may be formed to properly provide and operate a district under such conditions. Here is an article by the assistant general manager of the San Joaquin Light & Power Corporation at Fresno, which gives every detail necessary for such procedure in California. The paper is to be presented before the convention of the Pacific Coast Section of N. E. L. A. at Riverside as a part of the report of the Commercial Committee —The Editor.)

Highway Lighting Districts are formed under Act 1466, approved March 20, 1909. Stats, 1909, p. 551. Amended 1911, p. 439; 1913, p. 447; 1915, p. 943. This Act, including all of the amendments thereto, reads as follows:

(Exhibit A)

Act 1466

An Act to allow unincorporated towns and villages to establish, equip and maintain systems of street lights on public highways; to provide for the formation, government and operation of highway lighting districts; the calling and holding of elections in such districts; the assessment, collection, custody and disbursement of taxes therein; and the creation of ex-officio boards of supervisors.

"Approved March 20, 1909. Ctats. 1909, p. 551.) Amended 1911, p. 439; 1913, p. 447; 1915, p. 943.

1. The words and phrases used in this act, shall, for the purposes of this act, unless the same be contrary to or inconsistent with the context, be construed as follows:

(1) "Public highways," shall include any highway, county road, state road, public street, avenue, alley, park, parkway, driveway, or public place, in any county, or unincorporated town or village dedicated to the public and generally used for traffic by the public.

(2) "Street lights," or "street illumination," shall include any system of illumination by means of street lights using gas, electricity, or other means of illuminant deemed feasible; such lights to be set upon poles, or suspended in the air.

2. Any unincorporated town or village of this state may establish a highway lighting district for the purpose of installing and maintaining a system of street lights on public highways, for the better protection of its residents, in accordance with the provisions of this act.

3. Upon the application, by petition, of twenty-five or more taxpayers and residents of said town or village presented at a regular meeting of the board of supervisors of the county in which the said town or village is situated, praying for the formation of a public highway lighting district, and setting forth the name and boundaries of the said proposed district, the board of supervisors shall fix a day and hour for hearing the same, and protests of interested parties, not less than twenty-five nor more thirty days after the date of presentation thereof. The clerk of the board shall thereupon cause notices of the filing and hearing of such petition to be posted in three of the most public places in said district. Said notice shall be headed "Notice of the proposed formation of .... Lighting District" (stating name of the proposed lighting district), in letters not less than one inch in length, and shall, in legible characters, state the fact and date of the filing of such petition, the date and hour set for hearing such petition and protests of interested parties, specify the boundaries of the proposed district and refer to said petition for further particulars. The said clerk shall also cause a notice, similar in substance, to be published at least once a week for two consecutive weeks in a newspaper of general circulation printed and published in the county in which the proposed district is located and designated by said board for that purpose. Said notice must be posted and published, as above provided, at least seven days before the date set for the hearing of said petition. Any person interested, objecting to the formation of said district, or to the extent of said district, or to the proposed amendment, or to the inclusion of his property in said district, may file a written protest, setting forth such objections, with the clerk of said board at or before the time set for the hearing of said petition. The clerk of said board shall endorse on each such protest the date of its reception by him, and, at the time appointed for the hearing above provided for, shall present to said board all protests so filed with him. Said board shall hear said petition and protests at the time appointed, or at any time to which the hearing thereof may be adjourned, and pass upon the same, and its decision thereon shall be final and conclusive. If any of such protest be against the extent of said district, or against the inclusion of property in said district, then the board shall have power to make such changes in the boundaries of the proposed district as it shall find to be proper and advisable, and shall define and establish such boundaries, but said board shall not extend the boundaries of said district, nor shall said board modify such boundaries so as to exclude from such proposed district any territory which will be benefited by said improvement, nor shall any territory which will not, in the judgment of said board, be benefited by said improvement be included within such proposed district. At the expiration of the time within which protests may be filed, if none be filed, or if protests be filed, and, after hearing be denied or the boundaries of the proposed district be defined and established with modifications, as above provided, then said board shall be deemed to have acquired jurisdiction to further proceed in accordance with the provisions of this act.

The said board of supervisors must, within thirty days after acquiring jurisdiction to proceed as provided above, by resolution, order that an election be held in the said proposed district for the determination of the question, and shall appoint three qualified electors thereof to conduct said election; which must be held within forty days from the date of the order.

(Amendment approved May 29, 1915. Stats. 1915, p. 944.)

Election to Determine Proposition

4. Said election shall be called by posting notice thereof in three of the most public places in said proposed lighting district, and by publication in a daily or weekly paper therein, if there be one, at least once a week for not less than fifteen days. Said notices must specify the time, place and purposes of said election, give the boundaries of the said proposed lighting district; and the hours during which the polls will be kept open; provided that in districts with a population of ten thousand or over, the polls must be opened at 8 o'clock a. m., and kept open until 7 o'clock p. m., and in districts where the population is less than ten thousand, the polls must not be opened before 1 o'clock p. m., and must be kept open not less than six hours.

Conduct of Election

5. Said election shall be conducted in accordance with the general election laws of this state, where applicable, without reference to form of ballot or manner of voting, except that the ballots shall contain the words, "For Lighting District," and the voter shall write or print after said words on his ballot, the word "Yes" or the word "No."

Who Entitled to Vote

6. Every qualified elector, resident within the proposed district for the period requisite to enable him to vote at a

general election, shall be entitled to vote at the election above provided for.

7. It shall be the duty of the election officers to publicly canvass the votes immediately after the close of the election, and to report the result of said election to the board of supervisors, within five days subsequent to the holding thereof.

Duties of Supervisors.

8. If a majority of the votes cast at said election shall be in favor of a lighting district, the said board of supervisors may, by resolution, establish said lighting district.

9. If a majority of the votes cast shall be against the lighting district, the board of supervisors, shall by order, so declare; no other proceedings shall be taken in relation thereto until the expiration of one year from the date of presentation of the petition.

Evidence of Validity

10. The fact of the presentation of the petition, and the order establishing the lighting district, shall be entered in the minutes of the board of supervisors and shall be conclusive evidence of the due presentation of a proper petition, and that each of the petitioners was, at the time of signature and presentation of the petition, a taxpayer and resident of the proposed district, and of the fact and regularity of all prior proceedings of every kind and nature provided for by this act, and of the existence and validity of the district.

Supervisors to Act for Lighting Districts

11. The board of supervisors of the county wherein lighting districts have been established under the provisions of this act, shall be and they are hereby designated as and empowered to act as ex officio, the board of supervisors of each and all of such lighting districts which may hereafter be established within such county under the provisions of this act; serving without compensation; and said boards of supervisors shall be authorized and they are hereby empowered, and it shall be their duty:

Powers and Duties

First—To make all rules, regulations and laws necessary for the administration, operation and maintenance of the lighting districts situated within their county.

Second—To supervise, and plan a system of street illumination for any and all lighting districts within their county, and to determine and decide upon the kind and manner of illuminant most feasible for the district; but nothing herein shall prevent the board of supervisors from installing and maintaining electric lights on highways in such districts, and to pay for the same out of the general road fund of the county or district road fund.

Third—To indicate the placing and installation of the lights and any and all subsequent additional lights.

Fourth—To receive bids, award and make contracts with lighting companies to the very best advantage of the district, for the installation and maintenance of poles, wires, lights and other accessories; and for the supplying of electric current, gas, or such other illuminant as may be determined upon; and for any and all other things that may be necessary to carry out the full meaning and provisions of this act.

Fifth—To determine the number of employees, if any, necessary to properly care and maintain the lights; to prescribe their duties and fix their compensation, which said employees shall hold their positions at the pleasure of the board.

Sixth—Upon the application, by petition, of twenty-five or more taxpayers and residents of such lighting district, asking for the installation and maintenance of additional lights, which said petition must be filed on or before the first day of September in any year; to immediately estimate the cost of installing and maintaining such additional lights, and to include in the tax levy for the ensuing fiscal year a tax upon the taxable property within such lighting district, at the equalized value thereof for that year, sufficient to pay the cost of installing and maintaining such additional lights; after which to proceed with the installation of such additional lights.

Seventh—To designate the hours for lighting such districts.

Eighth—To perform any and all other acts and things necessary or proper to carry out the provisions of this act.

Ninth—To, within ten days after the establishment of such district, proceed with carrying out the provisions of this act by advertising for bids for installing, caring for and maintaining the lights determined upon; and for supplying the district with all the gas, electricity or such other illuminant as has been determined upon, necessary for operating and maintaining any and all of the lights which have been already installed or which are to be installed within such district. The contract to be awarded to the lowest responsible bidder; provided, however, that the rates to be paid therefore must not exceed in any event the rates paid at that time by said county for highway lighting in other portions of said county. The rates to be paid must not be fixed for a term exceeding five years, and the board of supervisors must reserve the right to abrogate such contract whenever gas or electric current is offered to be supplied at two-thirds of such fixed contract price.

Prior Light, Maintenance

12. If prior to the formation of a lighting district any lights have been maintained, by public subscription or paid for out of the district road funds, within any territory which subsequently forms itself into a lighting district under the provisions of this act; at the time of the establishment of such lighting district, or else at the time of expiration of any then existing contract for the maintenance of such lights; such lights and the future cost of maintaining and operating them shall be included in the estimate of the board of supervisors and shall thenceforth be maintained as a part of the lighting system of such lighting district.

Authority to Erect Poles

13. In granting authority to lay down pipes or to erect poles and string wires, and in contracting for gas or electric current, the board of supervisors must impose such restrictions and conditions, and provide for such locations of the various wires and lights, so as to work the least possible public or private inconvenience.

Estimate for Tax Levy

14. On or before the first day of September in each and every year the board of supervisors of any county wherein a lighting district has been established, shall make an estimate of the cost of conducting and maintaining such lighting district for the ensuing fiscal year, together with the cost of installing and maintaining such additional lights as may have already been petitioned for by the residents of such lighting districts, and for the cost of any other things which may be necessary for carrying out the purposes of this act.

Lighting District Tax Levy

15. When such estimate shall have been made, the board of supervisors of any county wherein a lighting district has been established, must, at the time of levying county taxes, levy a special tax upon all of the taxable property within the limits of such lighting district at the equalized value thereof, sufficient in amount to maintain the said lighting system, and to install any additional lights, or for any or all of the purposes of this act. When a lighting district is organized subsequent to the time of levying county taxes in any year, the board of supervisors may authorize the immediate installation of said lighting system in such district and shall include in the levy of taxes for said lighting district for the ensuing fiscal year, a sum sufficient to pay the cost of the installation and maintenance of said lighting system in said district for that portion of the preceding fiscal years

for which no levy of taxes was made in such year, for said purpose.

Disposition of Revenue

16. The revenue derived from said tax, together with all other moneys acquired in whatsoever manner by the lighting district, shall be paid into the county treasury to the credit of the lighting fund of the district wherein said tax was collected, subject only to the order of the board of supervisors of said district, and to be by them expended only for and on behalf of the district wherein such money was collected.

Designation of Districts

17. Every lighting district formed or established under the provisions of this act, must be designated by the name and under the style of .... lighting district, (using the name of the district), of .... county, (using the name of the county in which such district is situated), and in that name the board of supervisors may make and award contracts, and may sue and be sued.

Dissolution, Petition, Election, Disposition of Property, Outstanding Indebtedness

18. The district may at any time be dissolved upon the vote of two-thirds of the qualified electors thereof, at an election called by the board of supervisors upon the question of dissolution. Upon a petition signed by fifty or more property owners and residents of such lighting district, asking for the dissolution of said district, the board of supervisors shall within thirty days after receiving said petition, by resolution, order that an election be held in the said district, for the determination of the question, and appoint three qualified electors thereof to conduct said election. Such election shall be called and conducted in the same manner as other elections of the district. Upon such dissolution, any property which may have been acquired by such lighting district shall vest in any incorporated town or city where said lighting district shall be wholly within, or be identical with the corporate limits of such incorporated town or city; and the property in the territory of said district outside of the limits of such incorporated town or city shall vest in the county board of supervisors; and if there be no such incorporated town or city, then such property shall vest in the board of supervisors of the county wherein such lighting district is situated until the formation of such incorporated town or city; provided, however, that if at the time of the election to dissolve such district there be any outstanding indebtedness of such district, then, in such event, the vote to dissolve such district shall dissolve the same for all purposes excepting only the levy and collection of taxes for the payment of such outstanding indebtedness of such district; and from the time such district is thus dissolved until such indebtedness is fully paid, satisfied and discharged, the legislative authority of such incorporated town or city, or the board of supervisors, if there be no such incorporated town or city; is hereby constituted ex officio the board of supervisors of such district. And it is hereby made obligatory upon such board to levy such taxes and perform such other acts as may be necessary in order to raise money for the payment of such indebtedness, as herein provided.

The formation of lighting districts as outlined in the above Act can be made by the central station cooperating with the county district attorney's office. It may be advisable in some instances for the central station to prepare for the district attorney's office all of the papers in connection with the formation of these districts, or it may be advisable to prepare only a portion thereof. Some of the central stations are preparing all of the papers, and the outline herein contained will be upon the assumption that the district attorney's office will not prepare any of the papers.

As stated in the Act, the first action necessary is that the taxpayers and residents of the non-incorporated territory desiring the establishment of a highway lighting district prepare a petition praying the board of supervisors of the county to establish such lighting district. This petition may be in the usual form of petitions. This petition must definitely designate the boundaries of the district to be established. It may be necessary in some instances for an engineer to make a survey of the district in order to definitely fix the boundaries. This surveying may be done by the central station's surveyor. The petition must be signed by not less than twenty-five taxpayers who are residents of the lighting district to be established.

Upon the receipt of this petition from the signers thereof, usually transmitted to the board of supervisors of the county by the central station, the board of supervisors shall issue an order for the hearing of said application, and all protests, if any, of the interested parties not less than twenty-five nor more than thirty days after the presentation of such petition. The order of the board of supervisors is in the following form:

Exhibit "B"

Before the Board of Supervisors of the County of Fresno, State of California

In the Matter of the Formation
of
A Public Highway Lighting District,
To Be Known as .... Lighting
District of .... County.

A petition for the formation of a Public Highway Lighting District, to be known as "............ Lighting District of .... County," duly signed by more than twenty-five taxpayers and residents of the town or village of........ in the County of .... State of California, by which petition application is made by said taxpayers and residents for the formation of a Public Highway Lighting District, to be known as ".......... Highway Lighting District of .... County," with boundaries described in said petition having been filed and presented to the board of supervisors of the County of ...., State of California, at a regular meeting thereof held on the ...... day of .... 19.., and the board of supervisors having determined that said petition is in due form and is properly made and signed by more than twenty-five of the taxpayers and residents of said town or village of ...., within the exterior boundaries of said proposed Public Highway Lighting District.

It Is Hereby Ordered that the ...... day of .... 19... at the hour of ...... o'clock .... m., of said day at the rooms of said board of supervisors in the County Court House in the City of ......, County of ...., State of California, be, and the same is hereby fixed, as the day, hour and place for the hearing of said application, and protests of interested parties.

And It Is Further Ordered that the clerk of this board cause notices of the filing and hearing of said petition to be posted in three of the most public places within said proposed district, and to be published at least once a week for two (2) successive weeks in the ...., a newspaper of general circulation, printed and published in said County of ...., and within the proposed Public Highway Lighting District, which is hereby designated by said board of supervisors for that purpose, and which said notice shall be posted and published as above provided at least seven (7) days before said date set for hearing of said petition. Said

notice to be so posted shall have the heading thereof printed in letters not less than one inch in length and said notice to be posted and published shall be in the words and figures following, to wit:

BOARD OF SUPERVISORS,

By......................................

Clerk of the Board of Supervisors.

The clerk of the board of supervisors shall thereupon cause notices of the filing and hearing of such petition to be posted in three of the most public places in such district, and shall also cause a notice similar in substance to be published at least once a week, for two consecutive weeks, in a newspaper of general circulation, printed and published in the county in which the proposed district is located and designated by the board for that purpose. Such notice must be posted and published, as above provided, at least seven days before the date set for the hearing of said petition. The form of the notice to be inserted in the newspaper and posted at three public places is of the following form:

Exhibit "C"

Notice of the Proposed Formation of.............. Highway Lighting District of .... County

Notice Is Hereby Given that a petition and application for the formation of a Public Highway Lighting District, to be known as ".............. Highway Lighting District of .... County," duly signed by more than twenty-five taxpayers and residents of the town or village of ...., in the County of ...., State of California, and within the exterior boundaries of said proposed Public Highway Lighting District, was presented to and filed with the board of supervisors of the County of ...., State of California, at a regular meeting of said board of supervisors on the .... day of ...., 191.., and that the said board of supervisors fixed the .... day of ...., 19...., at the hour of .... o'clock ....m, of said day at the rooms of said board of supervisors, in the County Court House, in the City of ...., County of ...., State of California, as the time and place for the hearing of said petition, and the protests of interested parties.

The lands and premises included within said proposed Public Highway Lighting District are situated in the County of ...., State of California, and bounded and particularly described as follows, to wit:

(Here accurately describe the district boundaries as contained in the petition.)

All persons interested are notified to appear before the board of supervisors, of the County of ...., State of California, at the rooms of said board of supervisors, in the County Court House, in the City of..........; County of ...., State of California, on the .... day of.........., 19...., at the hour of .... o'clock ....m. of said day, then and there to show cause, if any they have, why said petition should not be granted and said Lighting District created and formed as therein prayed for.

By order of the Board of Supervisors this ...... day of ...., 19.....

BOARD OF SUPERVISORS,

By......................................

Clerk of the Board of Supervisors.

The party or parties designated by the clerk of the board of supervisors to actually post and publish the notice shall make a written affidavit that such notices have been posted and published. Form of affidavit is as follows:

Exhibit "D"

Affidavit of Posting of "Notice of the Proposed Formation of Lighting District of .... County"

State of California—ss.
County of ....

................................, being first duly sworn, upon oath deposes and says: That he is a citizen of the County of ...., State of California, over the age of eighteen years; that on the .... day of ...., 19...., he posted "Notice of the Proposed Formation of .... Lighting District of .... County," a copy of which is hereto attached and made a part and portion of this affidavit, in three of the most public places within the boundaries of said proposed Lighting District, to wit:
One at ....,
one at ....,
and one at ....,
that each of said notices so posted was headed "Notice of the Proposed Formation of .... Lighting District of .... County" in letters not less than 1 in. in length.

....

If upon or before the day set forth in the posted and printed notices no protests are made to the board of supervisors, either in writing or in person, then the board of supervisors shall be deemed to have acquired jurisdiction to further proceed in accordance with the provisions of this Act, and must, within thirty days after acquiring such jurisdiction, order that an election be held in the proposed lighting district for the determination of the question, and shall appoint three qualified electors thereof to conduct said election.

The board of supervisors shall pass an order granting the petition and calling the election. The form of that order is as follows:

Exhibit "E"

Before the Board of Supervisors of the County of ...., State of California

In the Matter of the Formation
of
.... Lighting District
of .... County.

Order Granting Petition and Calling Election.

The petition and application of more than twenty-five duly qualified taxpayers and residents of the town or village of ...., and of the district hereinafter described, in the County of ...., State of California, by which application is made by said taxpayers and residents for the formation of a public highway lighting district, to be known as .... Lighting District of .... County, with the boundaries in said petition and hereinafter described, coming on regularly to be heard before the board of supervisors of said County of .... on ...., the .... day of ...., 19...., at the hour of .... o'clock, ...m., and the said petition and application now at the said date and hour last named coming on to be heard, and it appearing to said board of supervisors that due notice of the hearing of said petition and application has been given by the clerk of this board as required by law and the order of this board heretofore made in that regard, and it further appearing to this board that no protests against or objections to the granting of said petition and application have been made or filed, and the said board of supervisors now hearing evidence offered in support of said petition, and being fully advised in the premises, it is, therefore, ordered by said board of supervisors that the said application and petiiton be granted, and that said .... Lighting District of .... County be established, if the electors residing within the boundaries thereof shall so decide at an election to be held for that purpose, and that said .... Lighting District

of .... County shall have the boundaries mentioned in said petition and application, which said boundaries are hereby defined and established as follows:

(Here copy the description of the district to be formed as contained in the petition.)

It is further ordered that an election be held in the said proposed district, for the determination of the question as to whether or not said .... Lighting District of .... County shall be established with the boundaries above described, which election shall be held at ...., in the village or town of .... County of ...., State of California, on ...., the ...... day of ...., 19.... and............ and ...., three qualified electors of said proposed district are hereby appointed judges to conduct said election.

It is further ordered that the clerk of this board be, and he is hereby directed to give notice of said election, and to call the same by posting notice thereof in three of the most public places in said proposed lighting district, and by publication of the same in the .... a newspaper printed and published in the village or town of ...., at least once a week for not less than fifteen days before said election.

It is further ordered that said notice specify the time, place and purpose of said election, and give the boundaries of the said proposed Lighting District as herein defined and established, and the hours during which the polls shall be kept open, namely, from 1 o'clock p. m. of said date to 7 o'clock p. m. of said date.

Said election shall be conducted in accordance with the general election laws of this state, as far as applicable, without reference to form of ballot or manner of voting, except that the ballot shall contain the words "For Lighting District," and the voter shall write or print after said words on his ballot the word "Yes" or the word "No."

Every qualified elector, resident within the proposed district for the period requisite to enable him to vote at a general election, shall be entitled to vote at the election above provided for.

It shall be the duty of the election officers above named to publicly canvass the votes immediately after the close of the said election, and to report the result of said election to this board of supervisors within five days subsequent to the holding of said election.

Adopted by the Board of Supervisors of the County of .... at a regular meeting of said board held on the .... day of ...., 19...., and by the following vote:

Ayes: Supervisors ....

....

Noes: ....

Absent: ....

Attest....................................

Clerk.

Notice shall be given the electors that such election will be held, by posting in three of the most public places of said proposed district, and by publication in a daily or a weekly paper therein, if there be one, at least once a week for not less than fifteen days. The form of the notice to be printed and posted shall be as follows:

Exhibit "F"

Election Notice

Pursuant to an order of the board of supervisors, duly made and entered in its minutes on the .... day of ...., 19....

Notice Is Hereby Given that an election will be held at ...., in the village or town of............ in the County of ...., State of California, on ...., the .... day of ...., 19..... Said election will be held to determine the question of the formation of a public highway lighting district, to be known as .... Lighting District of .... County, with boundaries proposed as follows, to wit:

(Here copy the description of the district to be formed as contained in the petition.)

Said election shall be conducted in accordance with the general election laws of this state as far as is applicable, and the polls shall remain open from the hour of 1 o'clock p. m. until the hour of 7 o'clock p. m. of said .... day of ...., 19....

For the purpose of conducting said election the board of supervisors has appointed ...., three qualified electors of said proposed district, as officers to conduct said election. It shall be the duty of said election officers above named to publicly canvass the votes immediately after the close of said election, and to report the result of said election to this board of supervisors within five days subsequent to the holding of said election.

Dated this .... day of ...., 19.....

....

Couny Clerk and ex officio Clerk of the Board of Supervisors of .... County, California.

By.................................

Deputy Clerk.

The party or parties designated by the clerk of the board of supervisors to print and post the election notices shall make affidavit to the board of supervisors that such notices have been posted and printed. The form of the affidavit is as follows:

Exhibit "G"

Affidavit of Posting of Notice of Election

State of California.—ss.

County of ....

.... being first duly sworn, upon oath deposes and says: That he is a citizen of the County of ...., State of California, over the age of eighteen years; that on the .... day of ...., 19...., he posted Notices of Election, a copy of which is hereto attached and made a part and portion of this affidavit, in three of the most public places within the boundaries of said proposed .... Lighting District of .... County, as follows, to wit:

One at the ....; one at.................... and one at ....

....

....

Subscribed and sworn to before me this .... day of ...., 19....

....

Notary Public in and for the County of ...., State of California.

The election having been held, the board of supervisors shall be advised as to the outcome of same. If a majority of the votes cast shall be in favor of the district, the board of supervisors may by resolution, establish such lighting district and at that time adopt rules, regulations and laws necessary for the administration, operation and maintenance of said lighting district, which rules and regulations shall include the kind of illuminant, type of lamp, etc., and as to whether or not the district shall make the installation of the necessary equipment or contract with the central station for the installation of the necessary equipment, together with a contract for the operation of the equipment. The central station usually agrees with the board of supervisors in advance of the adoption of resolutions, as to the type of service and the rates to be charged, and it is the

custom of the board of supervisors to embody in their resolution, rules and regulations that conform to the understanding previously had between the board of supervisors and the central station.

Exhibit "H"

Before the Board of Supervisors of the County of ...., State of California

In the Matter of the Formation
of the
.... Highway Lighting
District of .... County.

Resolution Establishing said Lighting District, Determining the Kind of Illuminant to be Used, and Establishing Rules and Laws Necessary for the Administration, Operation and Maintenance of said Distrct.

Whereas, heretofore, to wit.....on the.....day of..... 19...., there was duly filed and presented to the board of supervisors of the County of ...., State of California, at a regular meeting thereof, a petition for the formation of a public highway lighting district, to be known as ".......... Highway Lighting District of .... County," which was duly signed by more than twenty-five taxpayers and residents of the town or village of ...., in the County of ...., State of California, and by which petition application was made by said taxpayers and residents for the formation of a public highway lighting district, to be known as "............ Highway Lighting District of.............. County," with boundaries described in said petition and hereinafter described; and

Whereas, on the ...... day of ...., 19...., the said petition and application came regularly on for hearing before this board, and it then appearing that due notice of the filing and hearing of said petition had been posted, published and given as required by law and the order of this board, and no protests having been filed or made to the granting of said petition or to the establishment of said public highway lighting district, and no one objecting thereto, the said board of supervisors did thereafter, to wit, on the .... day of ...., 19...., by resolution order that an election be held in the said proposed district on the ...... day of ...., 19...., for the determination of the question as to whether or not said public highway lighting district should be established, and did appoint three qualified electors thereof to conduct said election; and

Whereas, After due and lawful notice of said election by posting and publication as required by law and the order of this board, said election was duly held in the said proposed district on the said ...... day of ...., 19...., at which election there was submitted to the qualified electors of said proposed district the question of the establishment of said public highway lighting district; and

Whereas, There has been duly returned to this board the report of the election officers duly appointed and qualified to conduct said election and who conducted the same, from which it appears, and this board now finding, that said election was regularly and duly held in said proposed lighting district on the .... day of ...., 19...., in accordance with the resolutions and orders of this board of supervisors and the notices posted and published therefor; that the polls at said election remained open continuously for not less than six hours, to wit, between the hours of one o'clock p. m. and seven o'clock p. m. on said day; that there were .... votes cast at said election; that "For Lighting District—Yes" received ...... votes, and "For Lighting District—No" received .... votes.

Now, Therefore, It duly appearing and this board finding that the proceedings heretofore had and held in the matter of the establishment of said public highway lighting district having been regularly and duly had and held, and that a majority of the votes cast at said election were in favor of said lighting district.

Be It Resolved, By the board of supervisors of the County ...., State of California, that said public highway lighting district be, and the same is hereby established, and that the same shall be known as ".......... Highway Lighting District of .... County."

And Be It Further Resolved, That said .... Highway Lighting District of Fresno County is established with the following boundaries, being the same boundaries as those described in said petition and in the notices heretofore posted and published in this proceeding, to wit:

The lands and premises included within said lighting district are situate in the County of ...., State of California, and bounded and particularly described as follows, to wit:

(Here copy the description of the district to be formed as contained in the petition.)

And Be It Further Resolved, That the following rules, regulations and laws necessary for the administration, operation and maintenance of the said lighting district be and the same are hereby made and adopted:

(Insert here whatever rules and regulations might be adopted by the board.)

Ayes: Supervisors ....
....
Noes: ....
Absent: ....
Attest: ....
Clerk.

Within ten days after the final establishment of the district and the adoption of rules and regulations governing the type of service, etc., the board of supervisors shall advertise for bids for installing, caring for and maintaining the lights determined upon, and for supplying the district with illuminant, as has been determined upon, necessary for operating and maintaining any and all of the lights which are to be installed within such district. Contracts to be awarded to the lowest responsible bidder, provided, however, that the rates to be paid therefor must not exceed in any event the rates paid at any time by said county for highway lighting in other portions of the county. The rates to be paid must not be fixed for a term exceeding five years, and the board of supervisors must reserve the right to abrogate such contract whenever illuminant is offered to be supplied at two-thirds of such fixed contract price.

The increased immunity from fire hazards experienced in transmission lines crossing the national forests is gratifying to all interested in the electrical industry. The number of fires suppressed on National Forest lands during the calendar year 1915 was 6324, as against 7018 in 1914, and an average annual number of 4759 during the past five years says Henry S. Graves, Chief of the Forest Service, in his annual report just published. While more than the average number of fires occurred the timbered area burned over was but 155,416 acres, or 30 per cent less than the average per year for the period 1911-1915 inclusive. The average loss per fire was $60.41. Forty-four per cent of the fires were confined to areas of less than one-quarter of an acre.

MERCHANDISING ELECTRICAL ENERGY

(The merchandising of electrical energy and energy consuming devices involves not only the highest skill in commercial practice, but especially does it require utmost efficiency in organization. Here are articles by well-known authorities on this subject that should commend themselves to every sales force in central stations throughout the West. The papers have been prepared as a part of the report of the Commercial Committee for consideration at the Pacific Coast Convention of N. E. L. A. at Riverside.—The Editor.)

COMMERCIAL ORGANIZATION

BY E. B. CRIDDLE

General Agent, Southern Sierras Power Company

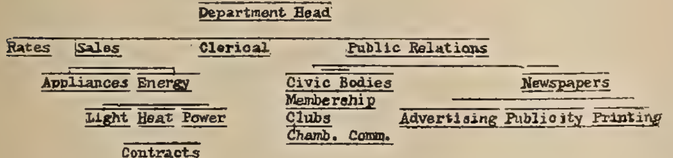
An efficient commercial department for an electrical corporation must be adapted to the size and operating conditions of the corporation; it may sometimes consist of one man, or there may be a large force. Some of the employes may be connected solely with the commercial department, while others may be in charge of the entire business of a given territory, reporting to and receiving orders from the heads of all departments.

The object of a commercial department and its business is to establish and maintain cordial relations of mutual respect and confidence with the public and by reasonable and fair dealing, and through this relationship, coupled with good salesmanship, to sell its output to the public; to supply to the public, energy for light, heat and power, displacing all other kinds of either form of energy.

In the accomplishment of this result, the scope of the department should embrace all branches of public relations and salesmanship, whether handled by one man for a small company, or under the general direction of a department head for a large company, with a number of sub-heads, each in charge of several skilled workmen.

The department head, with different western companies, holds usually one of the following titles: President, vice-president, general manager, general agent, manager of commercial department, commercial agent or superintendent. He must be a man of poise, fair-minded, level headed, diplomatic, courteous, industrious, loyal to the company, honest, truthful, a good judge of character; must understand thoroughly this company's rates, its policies, rules, regulations, practices, and be able to present clearly and effectively any proposition he may have in hand. He must also be capable of training his assistants to follow his example.

The organization has as many individual sub-heads as may be necessary, embracing the following branches of service:



In a small organization, the department head may be all things to all men; in a larger organization, the local representative in each territory may look after all the above branches of work, and in addition, look after operating, construction, collections and billing, reporting to the department head; or he may have a local organization similar to the above general organization, the detailed reports being made by the local men to the district manager, agent or superintendent, and by him transmitted in such detail as may be required, to the department head.

In a large organization, both at headquarters and in the various territories, the function mentioned will be performed by as many men as circumstances require. For instance, the head may be the general agent. He may be the rate expert, or may have a rate expert with various statisticians and assistants. In charge of sales, may be a sales manager or new business manager, who, if the organization is large enough, will have an appliance sales manager, under whose direction will work appliance salesmen, range salesmen and motor salesmen. Also, under the sales manager may be power salesmen and lighting or cooking or heating salesmen, each of whom will secure contracts for various kinds of service, to be signed, possibly by the salesman securing the same, then by the sales manager, the general agent and the president or vice-president, depending upon the practice of the company. In some companies, the sales manager and appliance manager report independently to the general agent or department head.

The clerical force—under a chief clerk, if the force is large—will consist of stenographers for letter writing, reports and contracts, filing clerk, statistical clerk, recording contracts and results per customer, per horsepower, per acre or per unit of product.

The department head, such of his assistants as may seem wise and the district managers, agents or superintendents should be members of the N. E. L. A., of the local chamber of commerce and certain clubs where business men may be met. The newspaper work may be handled by the department head, or he may delegate it to one or more. For instance, there may be an advertising expert, to prepare all advertisements; either the same man or another, who is a good writer, to prepare news articles, which the newspapers will welcome, of a nature to cultivate favorable public opinion to the company and its business. Local printing should be given to local papers, so far as practicable.

Having secured an efficient force, as many young men as may be found desirable should be in training to fill all these positions, working for several years as students or understudies. Such an organization, composed of efficient, loyal, industrious men, will make many friends for the company and secure much new business.

MERCHANDISING

BY A. W. CHILDS
Superintendent of Sales, Southern California Edison Company

It is not the intention in this paper to cover the general subject of merchandising of current consuming devices. That subject was so thoroughly and completely discussed in the report of the Committee on Merchandising presented at the San Francisco convention of the National Electric Light Association that no one has since attempted to add to or take from it. Our purpose will be to discuss the problem from the standpoint of the central station and the dealer, and to show first why the central station commenced merchadising; secondly why the central station is obliged to continue merchandising to a certain extent, and in the third place the co-operative opportunity of the dealer.

It makes a difference whether we look at the matter from the standpoint of merchandising only, or whether we also consider the question of load building. It was the necessity for a load that induced the central station to take the matter in hand in the first place, and it is from this viewpoint that they must, from time to time, consider the situation, otherwise the whole problem would be left with the department store and dealer.

Twelve or more years ago, when one of our Southern California central stations had a vision of load building possibilities through the use of lamp socket appliances, there was no knowledge on the part of the consumers concerning such devices and, consequently, no market for them. It was of considerable consequence to the company concerned whether the load was secured within a reasonable length of time or through a long drawn out process. If the central station handled the selling, it could utilize its buying power, absorbing the expense which always attends the successful introduction of new things and by placing a large initial order and by sending salesmen direct to its consumers, take the shortest and most direct route in getting the appliances in use.

The electric laundry iron was just coming out and was practically the only lamp socket heating appliance then known, so, with hope that the result would justify the venture, the responsibility was assumed and an order placed. We will not dwell upon the difficulties encountered in persuading the consumers to use the irons. Many were skeptical, looking upon them as a thing devised and foisted upon them for the purpose of unwarrantably increasing their bills for energy but, with persistent effort, the irons were left on trial with those who could be induced to accept them, and this broad, liberal policy was the beginning of a movement which has given that company a connected load in electric appliances alone of approximately 90,000 kilowatts without adding to the capital investment; and producing an annual revenue, on the basis of $3.60 per appliance per year, of $630,000.

During these early years, the manufacturers looked to the central station to market their products and gradually, as the central station placed the appliances in service, satisfied users carried the good news to their neighbors, many of whom endeavored to buy from the regular retail stores where they were accustomed to shop. Central station salesmen making systematic visits from house to house, hastened the conversion and, as inquiries began to come in, the interest of dealers and hardware and department stores, was engendered. As the installations increased, store sales also increased, and during the years that have elapsed the business of the dealer has consistently grown and enlarged due, to quite an extent, to the education of the public by the vigorous, persistent and continuous efforts of the central station.

The work of the central station has been and is to find new uses for appliances and to co-operate with the dealers in supplying the demand already created. The one is dependent upon the other. It is just as important in this age of electric progress that new uses be found as it is that attention be given to sales already stimulated and it is in this that the central station fulfills its mission to manufacturer, jobber and dealer in creating the demand as well as assisting in satisfying it and, by this means, making the appliance portion of its business self-supporting. On the other hand, the dealer has his function to perform in marketing appliances. When the consumer has been approached by a salesman of the central station, the germ of desire has been kindled and, the goods being seen on display in the windows of stores, the advantages portrayed by the salesman, are brought to mind and the dealer enabled to make the sale.

Had the central station, twelve years ago, laid down a plan for the dealers to follow in order to build up the enormous demand for electrical appliances which exists today, and told them to work the plan alone, they would not have done nearly as much business as they have been enabled to do through the co-operation of the company, nor would the company have secured its own large volume of sales and consequent load. Instead, the company said "Come on" and lead the way and, with at first an occasional glimpse of merchandising profits, becoming more constant as the years pass, the business has steadily enlarged until, last year the dealers of Southern California, instead of running second, outsold the central station.

Many central stations do not sell appliances consuming less than 500 watts and retailing at $4.50 to $7.50, such as toasters, irons, percolators and electric grills. This has left a clear field to the dealer for appliances selling at higher figures and consuming less current, such as sewing machine motors, vacuum cleaners and washing machines, the sale of which carries a substantial profit in each case. One Los Angeles dealer recently sold 160 vacuum cleaners in one month.

From the central station's standpoint, the uses of electricity are multitudinous and the only way the energy can be consumed is through appliances of one sort or another. These appliances are being added to as new uses are conceived. Furthermore, the present devices are not yet introduced into all homes, so that it would be very short sighted for the central station, anxious for the load, and with a perishable commodity going to waste, to wait for the dealer to build up the business to a point of saturation. Nor would it be fair to the consumer, because the central station lowers its rate as fast as consistent and as the load

factor increases. This is brought about by the greater use of appliances and all consumers benefit from the condition. For instance, one California company, having 1300 electric ranges in use, has announced that, when 2000 ranges are in service, a reduction of ½ cent per kw.-hr will be made for cooking service. It would be very poor business for all concerned to hold up this load and the consequent benefits to the consumer waiting for a sufficient number of customers to drop into the stores of the dealers and purchase enough electric ranges to bring the condition about. The central station cannot afford to sit and wait.

We are passing through the same process of evolution in introducing the electric range that obtained during the introduction of lamp socket appliances, with this advantage, that the popularity of the small devices has paved the way for the range. It is necessary, however, with the range as with the iron, to absorb a large expense for promotion work and for this reason it is essential during this promotion period that the central station sells the ranges itself.

There is some difference of opinion as to who should do the installing. It is important that the installation expense be kept to a minimum in order to get a large number of stoves in service, as this expense is high enough under the most favorable circumstances. We believe that, for the present, the central station should make the installations. As the business develops, it can be gradually worked around so that the installation work can be done by the contractors upon a profitable basis, but that time has not yet arrived. When the central station sells and installs the ranges, results are obtained more easily and quickly and the number of ranges thus spread around helps to promote the game. Dealers have not at stake the amount the central station has and their interest does not justify them in absorbing the promotion loss that the central station can afford to sustain. The greatest obstacle in electric range promotion is the first cost. This is obviated to a considerable extent where the central station sells and installs at a minimum margin of profit, on the installment plan.

The same thing is true of the household electric water heater, which is also in its promotion stage, although there are many cases here and there where the electric range sale or installation, and also the sale of the electric water heater, or its installation, owing to some peculiar condition, are being satisfactorily taken care of by a live dealer and, in such instances, the dealer is always sure of the co-operation of the central station.

We are told it is not possible for manufacturers to increase the profit to the dealer because there is a limit to the amount the consumer will pay for appliances, and there is a limit to the cost of production and, between these two limits must come the profit for the dealer, the profit for the jobber, and the profit for the manufacturer, after the expense of operation of each branch of distribution is provided for. Therefore, the interests of the manufacturer, jobber, dealer and central station being to a large degree mutual, the responsibility rests upon the central station to use the methods at its command for creating business and stimulating sales in all branches of the industry. There is a growing tendency to increase the price of lamp socket appliances so that the dealer may make the same profit on a small number of sales that he has heretofore made on a larger number. This policy will undoubtedly curtail the number of appliances put out and to that extent delay building up the load factor of the central station.

There has been some talk of a plan to secure uniform action by central stations, jobbers and dealers throughout the country, adopting a national advertising campaign and running seasonal specials, say six specials a year, each for sixty days. This plan has much merit, although the sales policies of all concerns are not the same and it might be that the seasonal specials selected would not be acceptable in each case.

Several large Northern California companies are not in the appliance business directly but are working through the jobbers, contractors and dealers, assisting them financially in their sales efforts. This plan, adopted a year or so ago, is a new departure and definite figures of the results are not yet available, but the experiences of the year have given many valuable points for future sales work.

The methods to be used in creating demand are:

First—Personal solicitation.

Second—Personal letters.

Third—Newspaper publicity.

Fourth—Show window and demonstrations in locations on main shopping streets.

The first method is the best. Personal contact with the prospective purchaser establishes confidence, carries the shopping district of the city right into the home where an attentive salesman is anxious to please, devoting his entire attention to the consumer, thus overcoming the indifference and lack of interest sales people sometimes show when the situation is reversed and the consumer visits the down town store. The central station in following the direct sales method has its prospects boiled down to actual users of electricity and, when the salesman goes to the home, he has a distinct target. In promiscuous advertising and general sales methods, there is estimated to be from 25 per cent to 50 per cent waste. There is considerable value also in the good will which the central station secures by having its representative come in direct contact with the customer every sixty or ninety days, fixing any appliance that may be out of order and attending to or reporting any complaint, thus breaking the clods, removing the weeds and keeping the ground in good, fertile condition. However, there are many who will listen to the central station salesman but buy from the local dealer, the sale coming as a direct result of the company's work. Possibly 15 per cent or 20 per cent would be a fair estimate of this number.

The dealer has found it rather expensive to carry out the personal letter plan. As a partial substitute, the central station is usually willing to enclose with its regular mailing bills, folders and pamphlets advertising appliances of merit and bearing suitable imprint.

Many dealers are using more or less newspaper advertising. The number is increasing and with the National advertising the manufacturers are doing and the display advertising of the central stations ending with the now familiar "For sale by So and So and by

all Electrical Dealers" often giving their names and addresses, a considerable amount of accumulative good is being accomplished.

The real problem of the dealer is how to reduce his expense and increase his sales and it is very gratifying to see the improvement that has taken place in recent years both in show windows and interiors of dealers' stores and to find the dealers getting into a better position to take care of the customers. We observe neat, attractive window displays, tastefully displayed stock, more stores with clerks acquainted with their stock and able to talk their wares in a common sense way and, best of all, more business ability and more intelligent figuring of cost of turn over and cost of doing business.

Such a condition shows decided progress and spells success. With the central station selling at list prices, confining its sales practically to ranges and water heaters, and with the added advantage of selling many of the higher priced articles on installments, made possible through the sales plans of some of the manufacturers, the small dealer has the opportunity of becoming a larger one and the large dealer likewise to become even more substantial, and as he breaks his way through and earns his place among successful business men, the central station will continue to stimulate the demand for the goods he has to sell and find new uses for electrical energy, thus enlarging his opportunities and broadening the scope of manufacturer, jobber, dealer and central station alike.

Among certain jobbers, dealers and contractors as well as among some central station men, there is an opinion that the central station should not handle or sell to its consumers any kind of electrical appliances. Some go so far as to say it is the sole business of the central station to generate, distribute and sell electrical energy and that the sale of all kinds of appliances should be left to others. A wise man has said "The best answer to all criticism; the best test of all work, is results." The science of load building is as much the duty of central station men as the generating of electrical energy. The improving of load factor and diversity factor, is absolutely essential to the well developed electric property. If the central station does not guide and control this important work, who is going to do it? We are measured by results and where the best results are obtained, the central station is developing its own business, as well as extending active co-operation to the manufacturer, jobber and dealer.

USEFUL MINERALS OF THE UNITED STATES

A new edition of the popular work entitled "Useful Minerals of the United States," is being published by the United States Geological Survey, Department of the Interior, as Bulletin 624. It is a revised, enlarged and up-to-date edition of a bulletin that was issued about two years ago. A large edition of that bulletin was published, but it soon became exhausted, and several thousand applications for it were received after the edition printed had been distributed.

Besides giving several thousand new localities of mineral deposits and adding more than 160 new mineral names to the glossary, the new bulletin furnishes considerable additional information concerning certain minerals, especially the uranium and vanadium minerals found in the high plateau region of the West.

COMPARATIVE SUMMARY OF CRUDE PETROLEUM MOVEMENT

The following comparative summary of crude petroleum movement in January, 1917, represents the operations of 91 pipe line and refining companies, who handle or receive oil from the various productive fields east of the Rocky Mountains, and is compiled from reports received by the United States Geological Survey, Department of the Interior, prior to February 27, 1917.

Crude Petroleum Moved From Field Sources

Barrels of 42 gals. each

Field	Jan. 1917	Dec. 1916	Jan. 1916
Appalachian	1,682,615	1,642,838	1,434,149
Lima-Indiana	287,999	251,134	274,293
Illinois	1,433,528	1,413,075	1,372,290
Oklahoma-Kansas	7,436,010	7,330,529	5,971,030
Central and North Texas	783,987	....	....
North Louisiana	....	....	....
Gulf Coast	....	....	....
Rocky Mountain	868,357	....	....

Crude Petroleum Delivered to Refineries or Consumers

Barrels of 42 gals. each

Field	Jan. 1917	Dec. 1916	Jan. 1916
Appalachian	2,206,642	2,111,567	1,919,649
Lima-Indiana	1,578,884	1,521,962	1,696,319
Illinois	540,907	502,548	544,019
Oklahoma-Kansas	4,006,295	....	....
Central and North Texas	821,277	....	....
North Louisiana	....	....	....
Gulf Coast	....	....	....
Rocky Mountain	589,779	....	....

Stocks of Crude Petroleum at End of Month

Barrels of 42 gals. each

Field	Jan. 1917	Dec. 1916	Jan. 1916
Appalachian	6,401,474	6,364,144	7,174,434
Lima-Indiana	3,794,289	4,122,779	4,498,166
Illinois	5.214,527	5,555,444	9,321,491
Oklahoma-Kansas	17,396,695	12,543,712	5,102,218
Central and North Texas	2,520,004	....	....
North Louisiana	....	....	....
Gulf Coast	....	....	....
Rocky Mountain	860,926	....	....

CO-OPERATION IN FOREIGN TRADE

Important excerpts may be gleaned from a recent address by E. N. Hurley, chairman of the Federal Trade Commission before the Commercial Club of Chicago:

Nowhere is co-operation among business men and between them and the government more essential than in the development of our export trade. For this reason, the Federal Trade Commission has urged upon Congress the importance of the passage of the Webb bill, which removes the doubt which now exists in the minds of many business men as to the application of the anti-trust laws to co-operative selling agencies or associations organized solely for the purpose of furthering our export trade. This bill has passed the House of Representatives by a large non-partisan vote, and was pending in the Senate, when the filibustering movement killed it in the closing hours of the last session of Congress.

General Weighing by the government of the United States mail carried on all American railroads commenced on March 27th and continues for thirty-five days. The ton-mile or weight has been the basis of mail pay ever since the roads began carrying the mails. The present postal administration advocates a change from that method to one by the car-foot-mile, or space basis.

ELECTRIC COOKING AND HEATING

(Electric cooking and water heating continue to engage the thoughtful attention of commercial departments of power companies of the West. The industrial applications of electric heating are also widening each day so that new ideas of presentation and new methods of organization are constantly being evolved to meet the problems that are continually arising. Here is an article by a member of the commercial staff of the Great Western Power Company and a second article by the head of the commercial department of the San Diego Consolidated Gas & Electric Company which should prove timely aids for such commercial campaigns. These papers are parts of the report of the Commercial Committee and are to be presented for discussion at the convention of the Pacific Coast Section of N. E. L. A.—The Editor.)

ELECTRIC COOKING AND WATER HEATING

BY J. B. BLACK

It is the sense of the committee that at the present time an elaborate and detailed report on the Range and Water-heater situation on the Pacific Coast is not in order. This decision is based on the fact that the Electric Range Report presented at the convention of the Northwestern Electric Light & Power Association in Seattle, in 1916, and the report of the Electric Range Committee presented at the National Electric Light Association Convention in Chicago, in 1916, have brought the fundamental points of progress practically up to date and there is very little to be added to them.

This branch of the electrical industry on the Pacific Coast has, of course, made progress during the past year, particularly in the development of the water-heater situation, but such progress has not taken the form of fundamental changes but has been more in the nature of a general working out and refinement of the principles already developed.

It was the thought that, inasmuch as both copies of the above-mentioned excellent reports are in the hands of practically all of the Pacific Coast Section members, the year's progress could be brought out to better advantage by a full discussion in the convention meeting rather than by the preparation of an elaborate report.

Training the Future Housewives in the Method Electrical—Domestic Science Classroom, Westminster College, Salt Lake City

The tests on water heaters made by the Pacific Gas & Electric Company, in connection with the report of the Electric Range Committee of the Northwest Electric Light & Power Association, together with certain tests on a thermally controlled heater by the Great Western Power Company, are included as data additional to that published in the Seattle and Chicago reports.

The range and water-heater situation in general is still one of the most intense interest, to practically all of the Pacific Coast Operating Companies, and while the methods of merchandising and of charging for the service rendered vary a great deal, the ultimate result—that of making the electric kitchen standard—is well on the road to accomplishment.

Advertising.—There is considerable difference of opinion as to the value of advertising in introducing electric cooking and water-heating. Many of the member companies have used stuffers and pamphlets, as well as newspapers and other advertising mediums, with varying and in some cases indeterminate results; but it is apparently unanimous that advertising while of certain value as an interest awakener is absolutely valueless unless handled as a helper to an energetic house to house campaign.

Electric Cooking.—Considerable improvement has been made by the electric range manufacturers in the quality of their product. Generally this improvement has taken the form of more substantial element supports, better quality and placing of elements, aluminizing or in some way preventing the formation of rust in the ovens, and a general strengthening of the weak spots which have developed.

Some of the manufacturers have shown a commendable spirit of co-operation with the central stations by going over the range installations in general and noting points at which trouble has developed. The result of this get-together spirit is reflected in the changes made in range design, which have tended in a large degree to eliminate many of the earlier troubles. Due to the many types of electric ranges on the market, the consumers' requirements are taken care of remarkably well. In fact, many of the central stations have seen fit to choose several of the more popular types and concentrate on their sale to the exclusion of all others. This method not only materially cuts down the stock investment for the central stations, but enables them to reward the progressive manufacturer and also to make the salesman's task easier by enabling him to concentrate his effort.

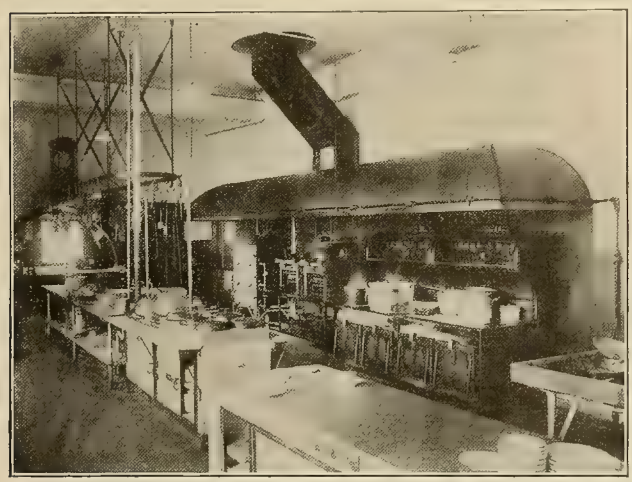
The question of voltage regulation is rapidly gaining the importance which it deserves, and the problem of Service, particularly in the rural districts, is more than ever vital.

There has been very little change in the attitude of the manufacturers or central station men in their preference for the open or closed type of elements, both of which have their adherents.

The rapidly increasing price of electric equipment, of course, multiplies the difficulties of the range salesman, and it is particularly important to the company just commencing sales activity in the range line to have the first cost of the electric installation as near

as possible to that of gas or coal equipment. Many of the central stations have found that it is advantageous to sell the range "installed," and it has been the general practice to turn over the range and make the installation at actual cost to the company. In some cases the company has even seen its way clear to make the installation at less than cost. The general tendency, however, seems to be to gradually raise the price of the range equipment to the standard list price at which the dealer operates. This may indicate possibly that the time is approaching when the central stations will be able to turn the merchandising of electrical ranges and water heaters over to the dealer, but certainly the time is not yet ripe, and the central stations will have to look forward to several years more of expensive development work before they can with safety withdraw entirely from the merchandising field.

Water-Heating.—The question of heating water electrically, and particularly in connection with electric range installations, is still characterized by a wide



Typical Electric Ranges and Broilers in Commercial Cooking

divergence of opinion among central station men. There is, however, a decided trend in the direction of placing the water-heating business, properly handled, on a par with the electric cooking business. From the standpoint of value to the central station a combination of the two is considered ideal, and in fact opinions have been expressed that the water-heating business alone (always assuming that it is properly handled) is even more valuable to the central station than the cooking business alone when considered from a standpoint of the sales effort needed, annual income per kilowatt, and the resultant load characteristics.

The vital problem lies, of course, in keeping the water-heating load off the range peaks. Two different methods of obtaining this result have been developed: First, placing the heater on a double-throw switch with the range, and second, employing the use of a thermally controlled "step type" heater operating directly on the line. This latter type of heater is finding greater favor recently, and it is particularly suited for working in parallel with a solar heater or the ordinary water-back installed in a furnace, or fireplace.

The two most important faults of the ordinary immersion or circulation type heater when installed on a double-throw switch with the range, are overheating or underheating due to abnormal or subnormal use of the range equipment by the housewife. These faults are completely overcome by the thermally controlled heater, and providing the load characteristics are such that the large water-heating demands will not coincide with the demands of the range, the thermally controlled heater will approach nearer to the ideal automatic electric kitchen, towards which we are striving, though due consideration must be given to the larger radiation losses when this type is used.

The question as to the use of the flat or meter water-heating rate is still an open one, and must be settled by each company in a way that will best fit its operating conditions.

When the water-heater is placed on a meter rate, it is very important to the consumer and ultimately to the central stations that every possible method of economizing in the use of electric energy be used.

The investigation and application of electric water-heating has lagged behind that of electric cooking, and it is very desirable that a full discussion of its merits and the problems to be met be invited at the convention.

The relation of storage capacity to the rate of use of water in the various classes of service to which electric water-heating may be successfully applied, and also the relation of storage to the kilowatt capacity, are of great importance, and probably more real advance in the solution of these problems has been noted than in any other phase of electric water-heating progress.

The installation of spring faucets, lagging, and a complete survey of both the plumbing installation and the habits of the various classes of domestic and commercial consumers must be made and allowed for in order to insure satisfactory service. This survey is particularly essential when the installation of a thermally-controlled heater on a meter basis is contemplated, as a very thorough study must be made in order to insure the resultant load characteristics which will enable the central station to grant the service the low rate which is necessary in order to make electric water-heating universally practicable to the consumer and at the same time profitable to the central station.

It is the opinion of the committee, that we are all more or less overlooking the importance of insulation in our study of the water-heating subject. Plant tests indicate that while the manufacturers are giving us a number of very reliable heaters, we have very few convenient and economical methods of insulating boilers and piping. We believe that from now on more attention should be given to this phase of the subject. If more of the losses can be eliminated it will go a long way toward solving the problem.

In the last report of the U. S. Bureau of Standards, it was announced that the most extensively used domestic commodity was matches; following it, a close second, came hot water. With the introduction of the electric range we like to think that we have effectively eliminated matches from the home. Having done this, the next problem of greatest importance to the householder is then hot water.

INDUSTRIAL ELECTRIC HEATING

BY A. E. HOLLOWAY

Commercial Manager, San Diego Consolidated Gas & Electric Company

Industrial electrical heating includes all the industrial applications of electricity in which electrical energy is converted directly into heat. This is a broad field and the possibilities of its development are unlimited.

Problems of Development.—The direct conversion of electric energy into heat is as old as the electrical industry, but the development of its application to industrial purposes has been very slow. The central station has been backward in exploiting industrial heating for the following reasons:

First—The absence of rate schedules that would be attractive to the customer and give a profit to the central station.

Second—The rapid development of the central station load due to power and lighting improvements calling for the entire attention of the manufacturers and central stations.

Third—The impossibility of standardizing apparatus or devices. A device successfully operated on one kind of work may not be applicable to the same kind of work for a similar manufactured product in another establishment, due to difference in size, degree of heat, etc.

Fourth—The direct comparison of the cost of heat units produced by electricity as compared with those of oil, gas or other fuels.

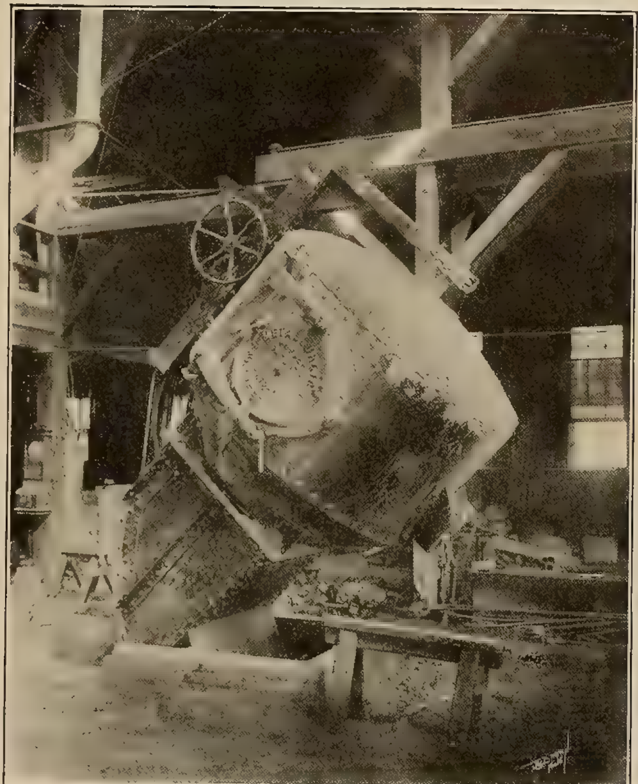
Fifth—The difficulty in demonstrating to the customer the convenience and economy to be found in the use of electric heat.

Sixth—The fact that each individual installation is an individual problem and must have individual attention from the central station salesman.

The prospective customer's first question is "What is the first cost?" His second question, "What is the cost of operation?" The first cost is not usually a serious obstacle but the cost of operation and maintenance needs careful consideration. Each proposition necessarily becomes an individual one and delays in making tests and cost estimation by the central station or the manufacturer often mean the loss of the prospect who resorts to the old methods which he knows will produce fairly good results.

What has Been Done to Develop the Heating Load.—Standard heating units have been developed by the manufacturing companies which can be used in many instances without modifications and they are at the present time developing new apparatus. This development work is rather expensive and most of it has been accomplished through the direct demand of the customer rather than by its exploitation by the central station and the manufacturer. We can name a great number of industrial heating installations which have been tried out and have proven successful, such as the enamelling oven, which is used both on a large and small scale, the electric furnace for high grade castings, glue pots and glue cookers for wood-working, soldering irons, core-baking ovens, welding machinery and many others.

At the present time the central stations have a great many proven industrial devices which they can exploit. By becoming familiar with and by introducing these appliances to the public, they will be able to more thoroughly study the industrial heating field for new applications for the manufacturers to develop. This will naturally, in the course of time, lead to a greater development of industrial heating. It is necessary that the manufacturers and central stations co-operate in giving to the customer the very best service possible and to help him solve his manufacturing problems in the electrical way. It is also essential that the central stations co-operate by furnishing each other information on installations which have proven successful. In the appendix to this paper will be found a list of industrial applications on which information



Electric Furnaces in the Steel Industries

is now available and which has been compiled by the manufacturers.

Points to be Taken Into Consideration in Iudustrial Electrical Heating.—There are numerous industries that use heat in some process of their manufacturing operation. In many cases, electric heat would prove more economical than any other form. In considering the advantages of electric heat, the following points of superiority must be kept in mind: chances for economy, ease of application, improvement of product, saving of labor and skill, accurate temperature adjustment, possibility of effecting operations otherwise impossible, reduction of floor space, absence of unhealthy products of combustion, lack of excessive room temperature, removal of fire and explosion risk, increased comfort, quicker and more efficient application and flexibility of operation.

In almost all cases on approaching a heating problem, we find that the heat units produced by electrical energy, as compared with the same amount produced by gas or oil, will cost considerably more; but it does not always follow that heating by gas or oil is the more economical. It is very essential to make a study of the proposed installations in order to get the proper appli-

cation of the electrical energy and it is necessary to become familiar with the requirements of your customer and with the method of manufacturing his product. It is often very hard to establish the prospective customer's confidence in electric service and to get him to change his methods and make new expenditures while he is getting along fairly well with his present system. It is the central station's greatest problem to prove to the prospective customer that by using electric heat his unit cost of production will be less in the end when at first appearance it would seem much higher.

Let us take for example the electric enamelling oven. Looking at the problem by comparing the cost of heat units produced by electric energy with the cost of those produced by other fuels, it would seem prohibitive to use electric heat. But taking into consideration that, due to the fact that the available heat is directly applied in useful work and it is not necessary to baffle or muffle to secure uniform heating, the electric oven insures a greater production with lower unit cost, inasmuch as the enamel can be baked from thirty to forty per cent faster. Furthermore, ventilation is not required to take care of gases of combustion, only a small amount being required for the escape of vapors and which can be entirely shut off as the temperature rises. The heat being furnished by radiation as well as convection makes the baking much faster, being more direct. The finished product surpasses that produced by gas or oil and it has a finer finish due to the complete absence of products of combustion. The electric heat further presents control which is automatic, eliminates the danger of explosion and insures a perfect job. With these considerations, the electric enamelling oven has proven the most economical.

There is no doubt at the present time, the cost of electric heat is prohibitive when applied to some industries,—unless a very low rate for energy be obtained. Either the application or the conservation of heat must be accomplished to a greater advantage than with other fuels or there is very little chance of securing the load. Every application made of electric service in the industrial field will be watched with great interest and therefore great care should be exercised in making careful recommendations where it is apparent that the advantages to be gained by the use of electric heat will not outweigh the economy to be effected by the adoption of fuels of low cost and high heating value.

It is necessary in making installations to see that the apparatus is properly installed and insures good service. The most important points to be considered are first, the proper application of the heat, and second, the conservation of the heat by means of perfect insulation. A successful installation will open up a wide field and an unsuccessful one may close a promising field.

How and Where to Secure the Industrial Heating Business.—Prospects for industrial heating will be found in the territory of every central station and its development depends upon the amount of time and study the central station will give in proving its right to obtain this load. It must not be expected that great results will be attained immediately but with the proper study of the field by the central station, together with the assistance of the manufacturing company, a great deal can be accomplished. Electric heating can be secured very easily in some industries by merely acquainting the prospect with its advantages. Examples of this are found where there is great fire hazard, where there is danger of explosion, where long and expensive steam lines are maintained for small amounts of heat or steam, and where the application of heat is difficult.

Laundries are always good prospects for electric irons and oftentimes the central station can secure the ironing load of a laundry where it cannot secure the power load, as it is more economical for the laundry to buy the electric energy rather than to generate. There can be found in every town a field for small enamelling ovens of from three to ten kilowatts capacity. At the present time the work is sent to the larger cities with great waste of time and money, whereas the installation of a small oven would enable the work to be done in the shop with the advantage of lower cost and better service. In towns with foundries, electricity for core baking ovens has the advantage over other fuels in uniform temperature, conservation of heat, speed, and the elimination of imperfectly baked cores; in other words, a much more uniform product can be procured.

The Motion Picture Film Dryer—Electrically Heated

It would be well for every power salesman to become thoroughly acquainted with the processes used and the equipment of power users. He should go into the shop or factory and suggest the advantages of electric heating when he himself is convinced that a change would improve conditions and be profitable to the customer in the end. This is a problem for the power salesman to solve, and by doing this, one use of electric heat will be the forerunner of another. Also the salesman will often times find the customer suggesting his own use. There is one thing about which every salesman of industrial heating must be careful, that is the selling of an appliance or installation to his customer which he himself knows will not be of any benefit to the customer or which will not better his operating conditions. It is essential that the salesman be truthful and if he does not believe he can better the customer's condition, he should recommend against the use of electrical apparatus and not lead the prospect into purchasing something which he himself knows will be unsatisfactory.

The committee finds that in addition to the uses mentioned by Mr. Holloway, where electric heating has proven entirely satisfactory, we should mention commercial bakeries. There are many now in operation in various cities, Salt Lake City probably having more than any other one city.

Attention might be called also to two electric furnaces installed in the Monarch Foundry and the Sampson Iron Works in Stockton, California, and another installed at the plant of the Enterprise Foundry Company in South San Francisco, California. These are new installations and no data is available at the present time.

FIFTY INDUSTRIAL APPLICATIONS FOR ELECTRIC HEATING

Bacteriological incubators, beer vat dryers, bookbinders' heaters and gelding wheels, branding discs.

Can capping machines, candy batch and chocolate warmers, celluloid embossers.

Electric furnaces, embossing press heaters, envelope gum dryers, enamelling and japanning ovens.

Fan drying equipments, foot warmers.

Glue pots and cookers.

Hood heaters. Hardening furnaces.

Instrument sterilizers, incubators.

Laboratory heating devices, laundry machinery and rolls, linotype metal melting pots. ,

Matrix dryers, metal melters, motion picture film dryer.

Oil tempering baths and compound melters.

Pallette die heaters, pallette ovens, paper seal moisteners, peanut roasters and heaters, photographic drying ovens, pitch kettles, pleating machines for dress goods.

Rectifier tube boilers, roofing material vulcanizer, roofing paper heaters.

Sealing wax pots, shoe relasters, soldering irons, solder pots, solution tanks, steam boilers, stills for distillation of water, swimming tanks.

Tailors' irons, thread wax heaters, tire vulcanizers.

Varnish tanks, vat dryers, velvet marking irons.

Welding outfits.

POINTERS INVOLVED IN ELECTRIC HEATING INSTALLATIONS

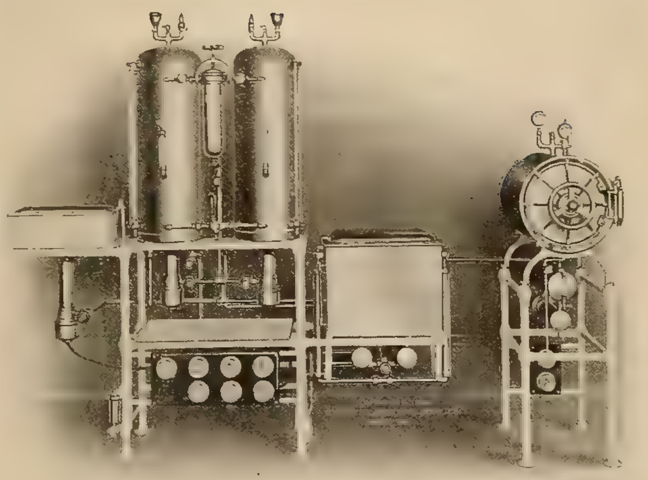
The following are a few items to be taken into consideration in making an installation of electric heating:

Problems Involved in the Heating of Water or Other Liquid

1. Amount of liquid.
2. Period of time for heating up.
3. Material of containing vessel.
4. Temperature maintained.
5. Whether vessel is insulated from radiation losses or can be so insulated. Kind and thickness of insulation.
6. Exterior surface of vessel (light or dark, rough or polished).
7. Kind of liquid.
8. Whether top of vessel is or may be covered.
9. Size and shape of vessel and space allowed for heater.
10. General operating conditions and special or unusual features.

Problems Involved in Steam Generation

1. Steam pressure desired.
2. Quantity of steam in pounds per hour.
3. Time allowed for bringing up to pressure from cold.
4. Detailed description of boiler to be heated with dimensions and construction.
5. General operating conditions and special or unusual features.



Typical Sterilizer Installation. (Left to right—Instrument, Water, Utensil, and Dressing Sterilizers)

Problems Having to Do With Japanning, Enameling and Other Baking Operations

1. Size of oven.
2. Shape of oven.
3. Temperature to be maintained.
4. Cycle of heating operation.
5. Weight of material to be baked.
6. How material is handled.
7. Duration of process.
8. Outside temperature of present oven.
9. Weight of trucks carrying material into oven.
10. Number of bakes required to produce finished product.
11. General operating conditions and special or unusual features.

Problems Involved in the Application of Electric Furnaces

1. Size and shape of chamber required.
2. Kind and quantity of work to be done.
3. Maximum temperature required.
4. General operating conditions and special or unusual features.

All Problems Involving the Application of Electirc Heat

1. Type of apparatus now being used.
2. Present cost of operation.
3. Amount of work to be done.
4. Present operating conditions and special or unusual features.

INTERESTING INSTALLATIONS OF INDUSTRIAL ELECTRICAL HEATING

Ford Motor Company—Enameling Ovens

Location: Los Angeles.

Size: Two ovens, 8 ft. by 8 ft. by 24 ft., approximately.

Temperature: Inside temperature 375° F.

Capacity: Heating elements, 225 kw. each.

Output: Average of 205 tons of auto fenders are baked in these ovens per month. Average consumption 45,000 kw.-hr. per month, or approximately 220 kw.-hr. per ton.

Fenders are dipped in enamel at a temperature of approximately 60° F. and are baked to an excellent finish in about 45 minutes.

When work is heated in an oil or gas furnace, it is almost entirely by convection. With the electric furnace the heat is given off partly by convection, but mainly by radiation in which the heat travels more rapidly and penetrates more completely.

Economy demands that the oven be effectively heat insulated and its interior walls be of low thermal capacity. The ventilation should be practically all cut off when the

work has reached a certain temperature to increase the efficiency of the oven.

Goodyear Shoe Repairing Company

Location: San Diego.

Appliance: Goodyear shoe stitcher.

Number of heat units: Three—

1. Thread heater.
2. Wax heater.
3. Bobbin warmer.

Control: Rheostat resistance.

Watts connected: Maximum, 400.
Minimum, 300.
Monthly, 150 kw.-hr. consumed.

Advantages: Absolutely constant heat. No boiler necessary as with gas. Faster to start, 15 to 20 minutes with boiler. More simple. Enclosed, dirt and grit being thus kept out of working parts.

Operation: Very satisfactory.

O. K. Tailor Shop

Location: San Diego.

Appliance: Pressing machine.

Manufacturer: Edwards Mfg. Co., Cincinnati, Ohio.

Number of heat units: One.

Control: 3 point switch.

Watts connected: Maximum, 3300.
Minimum, approximately, 1100.

Average consumption: 400 kw. per month.

Advantages: No odor.
Cleaner.
Less fire risk.
More convenient.

Western Lumber Company

Location: San Diego.

Use: Heating lumber preparatory to glueing.

Size: 2 ft. 6 in. by 2 ft. 6 in. by 10 ft.

Construction: 1 in. doubled with building paper between asbestos paper on bottom only.

Connected load: 2000 watts.

Inside temperature: 157° F.

Used to warm kiln-dried hardwood.

California Organ Manufacturing Company

Location: Van Nuys, California.

Use: Heating lumber preparatory to glueing.

Size: 2 3½ ft. by 3½ ft. by 16 ft. and 1 3 ft. by 4 ft. by 6 ft.

Construction of box: Galvanized iron with a 2 in. magnesia covering.

Kilowatt hour consumption: 55-75 kw.-hr., per 24 hours for three boxes.

Radiation Losses: 4.83 to 5.23 watts per sq. ft. of outside surface of box.

Inside Temperature: 158° F.

This is not used for drying lumber but to warm kiln-dried hardwood before applying glue.

Conditions could be materially improved by increasing lagging and painting inside with white enamel.

The Warman Steel Casting Company

Location: Redondo Beach.

Installation: One Stassano 3-phase electric furnace.

The equipment consists of a steel shell about fourteen feet in diameter and fourteen feet high, lined next to the steel with silicon brick and next to the metal with magnacite brick. Magnacite brick is necessary for the interior lining as the metal bath comes directly in contact with the furnace lining and magnacite is a neutral material, while the silicon brick has an acid base and is also unable to withstand the intense heat some 3500 degrees, Fahrenheit. The furnace is suspended on a double set of trunnions, the two sets being opposed so the furnace can be rocked or rotated, and the last five minutes of the heat the metal is agitated for the purpose of expelling any gases held in suspension so that when the metal is poured into the molds there will be no blow holes in the castings.

The electrodes are introduced through the lining on the sides of the furnace and are carbon, three and one-half inches in diameter and six feet in length. These carbons cost in the neighborhood of three dollars apiece, and while the furnace is hot, they last but twenty-four hours regardless of the amount of metal melted down.

The carbons are held in a long steel tube carbon holder that is surrounded by a cast iron water jacket and the electrode is advanced or withdrawn by being fixed to a hydraulic ram. Each electrode is controlled by a valve controlled by an operator constantly on duty while the furnace is kept hot, and once the furnace is warmed up, it must never be allowed to be cooled off during the life of the lining, as the cooling down of the furnace to a low temperature cracks the lining beyond repair and it would have to be torn out and replaced at an expense of about $400.

The above cost, together with the loss of a ton of metal, should it freeze up, through long extended interruption of service, is the principal reason for the great necessity of continuous service.

The lining is put in and when heated up under constant heat will last about fourteen days regardless of the number of charges of metal drawn off. Attached to the end of the carbon holders are 100,000 circular mill cables leading to a switchboard on which are mounted double throw switches, and the transformer connections can be so manipulated on the board that the furnace can be operated at 110 or 150 volts by changing from the delta connection to the "Y" connection on the secondary side.

The transformer capacity consists of three 100 kilowatt transformers with a ratio of 10,000 to 110-150 volts and are connected to the switchboard with busbar copper of a capacity sufficient to carry 1500 amperes.

The operator controlling the valves that move the electrodes back and forth, sits facing three ampere meters having a range of 2000 amperes, and he regulates the electrodes to keep the current within the range of from 800 to 1200 amperes. The ammeter guides him in his manipulation of the electrodes.

The average demand is about 225 kilowatts and draws about as follows:

At two or three o'clock in the afternoon the second heat is pulled off and then to keep the furnace warm until the next charge is put in, the furnace comes on for fifteen minutes, and then is off forty-five minutes. This operation is kept up from three in the afternoon until about four in the following morning. At four in the morning, part of the charge of metal is put in the furnace and melted down and from that time on at intervals of a few minutes the balance of the metal is introduced until 2000 pounds in all have been put in the furnace and brought to a molten state.

From the time the furnace is charged until the charge is poured off into the ladels the current is on continuously and the amount of time required to bring the metal to the proper condition seems to vary for some unknown reason and run from three and one-half to five and one-half hours.

The average kilowatt consumption for the reduction of one ton of metal is about 1100 kilowatt hours, and in spite of the fact that only two heats are drawn off each day and no heats taken off Sundays, the actual operation of the furnaces is about nine hours out of twenty-four and for that six men are continuously in attendance, two at a time on eight hour shifts, regulating the electrodes to keep the furnace heated during the fourteen days of its continuous run. One set of carbons is consumed each twenty-four hours regardless of the number of heats taken off.

N. E. L. A. COMMITTEE REPORTS

(The papers that comprise the subjects for discussion at the convention of the Pacific Coast Section of the N. E. L. A. have been arranged through the effective work of the commercial and engineering committees. With the exception of the paper on "Exhaustive Tests on Electric Water Heaters," by the commercial committee, which appeared in the columns of the Journal of Electricity in its issue of April 1, 1917, all of the papers that are to be presented at the convention may be found in this issue. By reference to the Table of Contents on page 322, any particular discussion desired may be readily found.—The Editor.)

GENERAL NOTATIONS ON PACIFIC COAST SECTION N. E. L. A. MEMBERSHIP

The first convention of the recently organized Pacific Coast Section of the National Electric Light Association, which now numbers over thirteen hundred members, and is the largest geographic section in the country, will assemble at Riverside, California, on April 19th for a three-day meeting. It will be attended by representatives of 49 electric light companies in the territory embraced by the States of California, Arizona, Nevada and New Mexico. Its membership represents an invested capital of approximately $500,000,000 with a gross revenue during the year 1916 of approximately $50,000,000. In the territory mentioned there are 73 hydroelectric plants, with an aggregate installed capacity of 600,000 h.p., and 21 steam plants with an aggregate installed capcity of 425,000 h.p., and with a connected load of approximately 2,000,000 h.p. The population served approximates 4,000,000 people.

The main purpose of this convention will be to provide ways and means for bringing electric service up to the highest possible point of efficiency, as well as at a minimum of cost to the public served, and to discuss all matters pertaining to the industry. One of the most important matters to be taken up will be the report of the Public Policy Committee, of which John A. Britton of San Francisco is chairman. The aims and objects of this committee are to thoroughly analyze all matters having to do with the public service, that is, in regard to the character of service furnished and the rates charged therefor, and to consider and advise upon legislation enacted by the State Railroad Commission and other regulating bodies

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REPORT OF THE COMMERCIAL COMMITTEE, PACIFIC COAST SECTION, N. E. L. A., RIVERSIDE, CAL., APRIL 19-22, 1917

Your committee had very little time to prepare this report as the appointments were not made until about February 1st. Two meetings were held, one in San Francisco on February 14th, and the second in Los Angeles on March 16th, practically an entire day being devoted to each meeting.

At each meeting all the members but one were present, the absentee being a different one in each case. At each meeting we were fortunate in having with us for a short time our Section Chairman, Mr. Ballard, and some of the other officers and committee chairmen, so that our deliberations were participated in by a very representative set of men. We hope our conclusions and recommendations will therefore be given due consideration.

Owing to the short time between the dates of our appointment and the Riverside Convention, we did not feel that we could go into the matter exhaustively, and decided that our report should consist of a general survey of conditions as they exist, such recommendations as we care to make for action at this convention and suggestions of the work to be carried out by next year's committee; our thought being to bring out the points that will promote real discussion at the Riverside meeting.

For convenience both in the preparation and use of the report, the work has been divided into six subjects, and each subject assigned to a member of the committee, with the idea that the discussion will follow in the same order.

1. Rates, by H. A. Lemmon of Reno.
2. Merchandising, by A. W. Childs of Los Angeles.
3. Electric Cooking and Water Heating, by J. B. Black of San Francisco.
4. Industrial Heating, by A. E. Holloway of San Diego.
5. Highway Lighting, by E. B. Walthall of Fresno.
6. Commercial Organization, by E. B. Criddle of Riverside.

Each member presented his subject at the Los Angeles meeting for discussion, and each subject is added hereto practically as presented at that time, together with the conclusions and recommendations of the whole committee.

Mr. Lemmon who has the subject of rates in charge has assembled the rate schedules of practically all the member companies, together with the rules and regulations. There is a noticeable difference both as to form and quantity which is probably to be expected among companies operating under such varying conditions, but it is hoped that certain standards of form at least will be arrived at in due time that will be of assistance particularly to the smaller companies.

It was the sense of the committee that the member companies be asked to send to the secretary's office enough copies of existing rate schedules and rules and regulations so that the secretary can provide each member company with a complete set, and furthermore, that new rates as they are adopted from time to time be sent to the secretary so that he can keep each member company's book up to date. This recommendation is made with the knowledge that the National Electric Light Association has just issued a rate book containing rates of all companies in the United States serving towns having a population of 40,000 and over, which book we do not consider fills the wants of this Section as four-fifths of its member companies are not covered.

In order to provide for discussion on this subject we felt it advisable to have a paper, and W. G. Vincent, valuation engineer of the Pacific Gas & Electric Company, has prepared a paper on this subject.

The paper on Highway Lighting includes a complete plan for the organization of lighting districts, in accordance with the laws of California. The advantages of boosting this class of business, both from the point of view of the central stations and the manufacturers and dealers, are obvious.

In addition to the duties assigned to the Commercial Organization by Mr. Criddle, as set forth in his paper, attention is called to the fact that it is found advantageous to have the matter of adjusting consumers' bills come under his committee, and it is the sense of the committee that this be included.

The committee is unanimous in suggesting the adoption of some plan whereby the smaller operating companies can get more direct benefit from membership in the Pacific Coast Section of the N. E. L. A., and it is the decided recommendation of the committee that the secretary's office be considered the clearing house through which the small companies can obtain competent salesmen when desired, from the larger companies. This plan will not only be of great assistance to the smaller companies, of which there are thirty-eight in the Pacific Coast Section, as against twelve of what would be termed larger companies, but will also directly benefit the larger companies by giving them an opportunity to send men out in the other districts for short periods to get experience that they could not get in their own companies. It is evident that if the association is to thrive it must be of value to every member, and if the smaller member companies realize that through the secretary's office, as a permanent organization they can get help at any time and on any subject, they will be quicker to see the benefit of active membership.

It is the sense of the committee that the member companies of the Pacific Coast Section get solidly behind the dealer and contractor movement, support the California State Association of Contractors and Dealers by helping it to create a fund for handling its work to better advantage, including the employment of a competent field man, and take advantage of the large volume of advertising, both national and local, already in the field, to the end that the central station of this territory may get the benefit to the fullest extent, of all elements that go to make up the industry.

We believe that the electric cooking and water heating subject is one of the most important before the member companies at this time, and urge that this subject be given full consideration in next year's activities. We purposely have not mentioned in this report any details in connection with this subject, except the laboratory tests, as we did not have the time to make a proper investigation and have refrained from commenting on the number of ranges and water heaters installed by the member companies, of which there are a great number, particularly among the companies in the southern part of California.

We believe that the member companies will benefit by fuller co-operation with the organization of contractors and dealers, with the thought in mind that in the contractors and dealers the central stations have active and energetic salesmen without the necessity of having these men on their pay rolls. We believe the time will come when the central stations can leave the merchandising subject entirely in the hands of the dealers, with such supervision as must naturally be exercised by the central stations to get the best results for all interests.

We wish to express our appreciation to the member companies and to others for the promptness and courtesy they have shown us in replying to our requests for information, and we believe the spirit of co-operation shown in this way indicates that all the member companies are alive to the value of this association.

In conclusion, we desire to call attention to the importance of having the work of the commercial committee continuous, and we believe this can be carried out through the secretary's office. We further recommend, in addition to such recommendations that have been made on each of the subjects in this report, that attention be given to the printing, in handy form for use, of a rate book containing all the rates and rules and regulations of the member companies, and that next year's committee give particular attention to the question of arriving at some standards as to forms for rates.

S. V. Walton, chairman; H. L. Aller, J. B. Black, A. W. Childs, E. B. Criddle, A. E. Holoway, H. E. Lemmon, E. B. Walthal, R. M. Alvord, D. E. Harris, J. W. Redpath,

REPORT OF ENGINEERING COMMITTEE

This committee was appointed by President Ballard on January 17, 1917, with instructions to make a general survey of the engineering situation, reporting conditions as they exist, with recommendations for the future.

In the limited time available between that date and the preparation of this report, the committee has attempted to collect information for the consideration of the Section on subjects of greatest local interest, eliminating as far as possible subjects of greater interest to other sections. The committee has also outlined some future work, in which we should appreciate the co-operation and assistance of the engineering departments of the member companies. We should also appreciate recommendations on other work which may be desired by the Section.

Transformer Standardization

We have co-operated with the apparatus committee of the national body in an endeavor to standardize the size, nominal voltages, voltage ratios, taps and series multiple arrangements of the various lines of transformers, particularly distribution transformers. Before the organization of this committee, Mr. S. J. Lisberger was engaged in this work as a member of the apparatus committee of the national body. Members of this committee and other distribution engineers went into this matter thoroughly with Mr. Lisberger in meetings in San Francisco and Los Angeles in February, after which Mr. Lisberger went East and attended a meeting of the national committee, with the result that the needs of this Section were ably presented and recognized in the new standard line, par-

ticularly in the distribution transformers of 6600/11000Y volt class. These, at our suggestion, have been given a triple rating similar to that of the 2200 volt class, with ratios and taps suitable for banking with transformers previously used in this section and sufficient to allow for the considerable drops required in our rural lines of this voltage with their seasonal loads. The details of the standardization appears in Mr. Lisberger's report.

Distribution Fuses, Switches

A subject of vital interest to the small as well as to the large operating companies is the protection of distribution transformers of various voltages against overloads and short circuits, with its attendant train of maintenance costs, interference with service, life and fire risks, single phasing and consequent motor damage, and high first cost of equipment to avoid these difficulties. This subject has been handled in Mr. Cunningham's paper with accompanying comments on the same subject by several other distribution engineers.

Prime Movers

In the matter of prime movers, this Section is interested in steam turbine operation chiefly as a standby feature, a paper on which is submitted by Mr. Morgan,—also in water wheels of the impulse and high turbine type, information on the latter of which follows, presented by Mr. Jollyman. The committee attempted to obtain information on the operation of internal combustion engines in central station work, without success.

Porcelain Line Insulators

Insulators have been a vexing problem to us all. The deterioration of porcelain insulators had been studied by a committee of your engineers previous to the formation of the Section, with the co-operation of Professor Ryan of Stanford University, and utilizing the equipment of the high tension laboratory of that institution. This study was limited to the vacation season when the equipment and personnel of the University were available, and it developed several lines along which additional work should be carried out. The engineering committee requested the National Bureau of Standards to undertake an investigation of the ceramic problems involved, and this matter was taken up personally by Mr. Lisberger while East with Doctor Rosa of the Bureau. The following is Mr. Lisberger's report on this situation:

March 26, 1917.

Chairman, Engineering Committee,
"Mr. J. E. Woodbridge,
Pacific Coast Section, N. E. L. A.

"Dear Sir: Confirming request made by yourself, as chairman of the Engineering Committee, of the Pacific Coast Section, N. E. L. A., I have to advise that while in the East I visited Doctor Rosa of the Bureau of Standards, consulting with him regarding the possibility of carrying on an investigation that would lead to the satisfactory design of a suspension insulator unit.

"Dr. Rosa received me most cordially and was very much interested in the work as outlined in your letter to him. He agreed that it was a very important problem as the present product turned out by the manufacturers did not seem suitable for the work to which it was being put. In talking over with him how the work could be financially undertaken, he advised that the government had not appropriated the amount of money asked for by the Bureau and that sufficient funds would not be available from the Bureau fund, to properly carry out the work. In discussing the matter further with him he advised that he thought it would take at least $15,000 or $20,000 to make a proper study and that if the industry would donate half the sum required the Bureau would donate the other half to carry on the work; the money to be appropriated by the industry from time to time as the requirements of the situation would dictate.

In keeping with my wire to you, I conferred with Mr. McClelland in New York with no definite results as yet. He stated, however, that he would give the matter some further thought. I advised him that he would probably hear from you as soon as I had returned to make my report: Incidentally, Mr. McClelland is considering coming west at an early date and you might be able to consult with him further personally."

The work undertaken by your engineers at Stanford University last year is being continued by Professor Ryan. Professor Ryan outlines his plan in this respect as follows:

"During the present spring we will study the quality of porcelain of all unmounted units on hand, about 135, by the heat they develop when subjected to sustained radio frequency electric fields; also of units that have failed and, for control, units that have not failed, by impregnating fragments with colored water at 1000 lbs. per square inch, by the study of particles and thin sections with the polarizing microscope and by the heating of fragments mounted in strong electric fields at radio frequency."

Professor Ryan also outlines a study to be made by a graduate student on the hardness, toughness and brittleness of a large amount of suspension insulator porcelain now at the University. Briefly this study will be made as follows:

"1. Hardness through the rebound of a diamond headed rock.
2. Toughness through deformation by impact through a steel ball upon properly mounted specimens.
3. Brittleness as indicated by abrasion:
   a. In rattler.
   b. Steel ball mill."

The manufacturers of suspension insulators have each had several types of interconnecting hardware, most of which have in the past been incapable of direct interconnection between types. The engineering committee appointed Mr. Klauber as a sub-committee of one to recommend standard dimensions of pin and clevis type. Mr. Klauber found that the manufacturers had already co-operated in this manner as shown in his report.

Mr. J. P. Jollyman has made a meritorious recommendation looking toward the standardization of pin type insulators, as per the following letter:

March 26, 1917.

"Mr. J. E. Woodbridge,
Chairman, Engineering Committee,
Pacific Coast Section, N. E. L. A.

"Dear Sir: I suggest that the Engineering Committee investigate the question of adopting standards for pin type insulators.

"The object of this investigation would be:

"1. To gather information from our member companies on the sizes and shapes of insulators now purchased for their several operating voltages.

"2. To select from the types now purchased or available, a minimum number of sizes of the best available shapes which will meet our requirements.

"3. To study the shapes selected and take up with the manufacturers any improvements in design which our experience may suggest.

"Such an investigation should reduce the number of shapes and sizes now purchased for substantially the same service and should enable the manufactures' agents to carry better local stock and quote us somewhat better prices."

The chairman of this committee has appointed Mr. Jollyman a sub-committee of one to carry out the work which he recommends.

Joint Pole Construction

The advisability of joint pole construction on city streets has been generally recognized. The advantages of the same type of construction on rural highways are now becoming evident The paper by Mr. MacDonald outlines clearly the tangible and intangible merits of such construction and gives many valuable hints on the organization and routine required for such work.

Inductive Interference

Since the publication of its preliminary report to the California State Railroad Commission, dated July 7, 1914, embodying recommendations for rules which were adopted by the commission and constitute General Order No. 39, the Joint Committee on Inductive Interference of the State of California has carried out a large amount of additional experimental work and computations and is at present engaged in drafting recommendations for the revision of the rules now in force.

The experimental work has been directed mainly to determine whether or not it is possible to avoid similar experimental work in all the various cases that arise. For example, the induction in the parallels that have been available for experimentation has been computed from the known physical constants of the circuits with no reference to the results derived experimentally, and has been compared with such experimental results to determine whether the amount of induction can be computed with reasonable certainty without tests. The results of this comparison show that the relative amount of induction from untransposed parallels of different lengths, separations, configurations, balance, wave shape, etc., can be computed from the dimensions of the circuits without experimental tests with an accuracy comparable with that of the assumptions which usually have to be made as to the amounts of load, balance, wave shape, etc. Such computations have been made for all of the several kinds of induction, electric and magnetic, due to either balanced or residual voltages or currents, over the complete practical range of separation and power circuit configurations, including a large number of cases of twin circuits. This involved an enormous amount of work, the results of which appear in more than 3000 curves on 212 curve sheets.

A large amount of work has been done on the effect of extraneous currents on telephone conversation at the request of the committee by the American Telephone & Telegraph Company, resulting in the design of a new telephone transposition system especially adapted to power line exposures.

Based on the computations above outlined, certain configurations of power lines, both single and double circuit, and certain interconnections of twin circuit lines have been found to be preferable. It appears desirable to require transpositions for the purpose of balancing the capacitance of lines to ground and some other precautionary measures are recommended on all future construction, with certain exceptions, instead of only one lines involved in parallels. This is for the reason that such lines may later become involved in parallels, at which time it is much more difficult and expensive to install transpositions or make other alterations than when the line is under construction.

On account of the demand for a specific definition of what constitutes a parallel with a telephone or telegraph line, the committee is setting forth the factors to be considered and is presenting such information as is possible on the length of exposure that may require power line transpositions to reduce induction, this information being given for the practical range of separation between lines, power line voltages, various power line configurations, and with assumptions as to wave shape, shielding, telephone line unbalances, effect of other exposures, etc.

The necessity has arisen for a basis of division of costs for avoiding or mitigating interference in cases of parallels proposed or created hereafter. Accordingly the committee is giving consideration to this phase of the problem and expects to present a basis which will be applicable to the general case.

Rules and Regulations for Line Construction in California

The California State Railroad Commission proposes to revise its existing General Order No. 26 covering overhead line construction at crossings, and to modify same to make it constitute a general safety code for overhead lines. This committee has offered its assistance to the engineers of the commission to the extent of constructive criticism of the proposed new general order and in any other way that may be desired by the commission. This offer has been accepted by the engineers of the commission and this committee has appointed a sub-committee, consisting of Messrs. S. J. Lisberger, E. A. Quinn and R. E. Cunningham to carry out this work. It is the hope of the engineering committee that this sub-committee may be made a clearing house in this respect for member companies in California, so that the recommendations of the power interests may not conflict and may be of as great assistance as possible to the commission's engineers.

J. E Woodbridge, chairman; H. A. Barre, J. P. Jollyman, L. M. Klauber, J. A. Koontz, C. O Poole, James M. Shepard, J. C. Scrugham, W. C. Hornberger.

The manufacture of nitrogen products from the air, heralded as a possible utilization of Western water powers, will need an abundance of natural lime deposits. The Pacific Coast states, including Idaho, produced 95,000 short tons of lime in 1916, or 3 per cent more than in 1915. This quantity included 13,000 tons of hydrated lime, produced in California and Washington, a gain of 14 per cent. Increase in total production was made in California and Idaho.

REPORT OF ACCOUNTING COMMITTEE

The committee finds that all member companies in the various states within the boundaries of the Pacific Coast Section are operating under classifications of accounts prescribed by their various state commissions, with the exception of those companies in the state of New Mexico. Public utilities doing business in New Mexico do not come under the regulation or control of the State Corporation Commission, therefore the commission has not adopted any classification of accounts with reference to such companies. Submitted hereunder for comparison are the balance sheet accounts of these classifications, together with those prescribed by the Interstate Commerce Commission and the National Electric Light Association. The Nevada and Arizona classifications are very similar, but with this exception a lack of uniformity exists between the various classifications of accounts, as an inspection thereof will indicate:

Balance Sheet—California

Assets—

Fixed capital installed prior to Jan. 1, 1913.
Fixed capital installed since Dec. 31, 1912.
Total fixed capital.
Cash and Deposits.
A. Cash.
B. Special deposits.
Total cash and deposits.
Notes Receivable.
Accounts Receivable.
A. Accounts with system corporations.
B. Due from consumers and agents.
C. Miscellaneous accounts receivable.
Total accounts receivable.
Interest and Dividends Receivable.
Other Current Assets.
Investments.
A. Securities of other corporations.
B. Advances to system corporations for construction, equipment and betterments.
C. Miscellaneous investments.
Total investments.
Materials and Supplies.
Sinking Funds.
Other Special Funds.
Treasury Securities.
Prepaid Expenses.
A. Prepaid rents.
B. Prepaid taxes.
C. Prepaid insurance.
D. Other prepayments.
Total prepaid expenses.
Unamortized Discount on Securities and Expenses.
A. Stocks.
B. Bonds.
C. Miscellaneous.
Total unamortized discount on securities and expenses.
Other Suspense.
Construction Work in Progress.
Corporate Deficit.
Total Assets.

Liabilities—

Capital stock.
Installments on stock subscription.
Funded debt.
Receivers' certificates.
Advances from system corporations for construction, equipment and betterments.
Notes payable.
Accounts payable.
A. Accounts with system corporations.
B. Audited vouchers and wages unpaid.
C. Consumers' deposits.
D. Miscellaneous accounts payable.
Total accounts payable.
Interest accrued.
Taxes accrued.
Dividends declared.
Service billed in advance.
Reserve for accrued depreciation.
Reserve for amortization of intangible capital.
Unamortized premium on debt.
Casualty and insurance reserves.
Income invested since Dec. 31, 1912—in fixed capital.
Reserves invested in sinking funds.
Other reserves from income or surplus.

Corporate surplus unappropriated.

Total Liabilities.

Balance Sheet—Arizona

Assets—

Property and Plant:
Cost beginning of year.
Construction and equipment current fiscal year.
Cost close of year.
Treasury Securities:
Treasury stock.
Treasury bonds.
Investments:
Stocks and bonds of other companies.
Other investments.
Reserve, Sinking and Special Fund Assets:
Depreciation reserve fund.
Sinking fund.
Amortization reserve fund.
Special funds.
Current Assets:
Cash.
Notes and bills receivable.
Accounts receivable.
Interest and dividends receivable.
Material and supplies.
Miscellaneous current assets.
Prepaid Accounts:
Prepaid insurance.
Prepaid taxes.
Prepaid interest.
Miscellaneous prepaid accounts.
Open accounts.
Deficit.
Total Assets.

Liabilities—

Capital Liabilities:
Capital stock preferred.
Capital stock common.
Funded debt.
Mortgage Liabilities:
Real estate mortgages.
Other mortgages.
Reserve Liabilities:
Depreciation reserve.
Sinking fund reserve.
Amortization reserve.
Special reserve.
Current Liabilities:
Notes and bills payable.
Accounts payable.
Matured interest on funded debt unpaid.
Matured interest on notes and bills payable unpaid.
Dividends unpaid.
Deposits.
Miscellaneous current liabilities.
Accrued Liabilities:
Accrued insurance.
Taxes accrued.
Unmatured interest on funded debt accrued.
Unmatured interest on notes and bills payable accrued.
Dividends accrued.
Miscellaneous liabilities accrued.
Open accounts.
Surplus.
Total Liabilities.

Balance Sheet—Nevada

Assets—

Property and Plant:
Cost beginning of year.
Construction and equipment current fiscal year
Cost close of year.
Treasury Securities:
Treasury stock.
Treasury bonds.
Investments:
Stocks and bonds of other companies.
Other investments.

Liabilities—

Capital Liabilities:
Capital stock preferred.
Capital stock common.
Funded debt.
Mortgage Liabilities:
Real estate mortgages.
Other mortgages.
Sinking Fund Liabilities:
Sinking Fund.
Special fund.

Sinking Fund Assets:
- Sinking fund.
- Special funds.

Current Assets:
- Cash.
- Notes and bills receivable.
- Accounts receivable.
- Interest and dividends receivable.
- Material and supplies.
- Miscellaneous current assets.

Prepaid Accounts:
- Prepaid insurance.
- Prepaid taxes.
- Prepaid interest.
- Miscellaneous prepaid accounts.

Open accounts.
Deficit.

Total Assets.

Current Liabilities:
- Notes and bills payable.
- Accounts payable.
- Matured interest on funded debt unpaid.
- Matured interest on notes and bills payable unpaid.
- Dividends unpaid.
- Deposits.
- Miscellaneous current liabilities.

Accrued Liabilities:
- Accrued insurance.
- Taxes accrued.
- Unmatured interest on funded debt accrued.
- Unmatured interest on notes and bills payable accrued.
- Dividends accrued.
- Miscellaneous liabilities accrued.

Open accounts.
Surplus.

Total Liabilities.

Balance Sheet—New Mexico.

Public utilities doing business in New Mexico do not come under the regulation and control of the State Corporation Commission, therefore the commission has not adopted any classification of accounts with reference to such companies.

Balance Sheet—National Electric Light Association

Assets—

PLANT INVESTMENT
- Plant investment.
- Unfinished plant investment. See Schedule "B"

CURRENT ASSETS
- Quick Assets:
  - Cash.
  - Notes receivable.
  - Accounts receivable.
  - Other quick assets.
- Business Assets:
  - Materials and supplies.
  - Prepaid accounts.

OTHER ASSETS
- Investments.
- Reacquired securities.
- Sinking funds—Invested.
- Sinking funds—Uninvested.
- Special deposits.
- Treasury securities.

SUSPENSE
- Debt discount and expense.
- Abandoned property.
- Jobbing accounts.
- Clearance, equalization and apportionment.
- Other suspense.

Liabilities—

CAPITAL STOCK
- Preferred stocks.
- Common stocks.

DEBT
- Funded Debt:
  - Bonds.
  - Other funded debt.
- Current Liabilities:
  - Notes payable.
  - Accounts payable.
  - Consumers Deposits.
  - Dividends payable.
  - Bond interest matured.
  - Other current liabilities.
- Accrued Liabilities:
  - Taxes accrued.
  - Interest accrued on funded debt.
  - Interest accrued on unfunded debt.
  - Other accrued liabilities.

RESERVES
- Permanent and Corporate Reserves:
  - Premium on capital stock.
  - Unamortized premium on debt.
  - Sinking fund reserves.
  - Other permanent reserves.
- Operating Reserves:
  - Renewal and contingency reserve.
  - Casualty insurance reserve.
  - Other temporary operating reserves.

PROFIT AND LOSS
- Profit and Loss—See Schedules "C" and "D".

Balance Sheet—Interstate Commerce Commission

Assets—

Investments:
- Road and equipment.
- Sinking funds:
  - Total book assets at date. (In short column).
  - Carriers own issues at date. (In short column).
  - Other assets at date. (In long column).
- Deposits in lieu of mortgaged property sold:
  - Total book assets at date. (In short column).
  - Carrier's own issues at date. (In short column).
  - Other assets at date. (In long solnmn).
- Miscellaneous physical property.
- Investments in affiliated companies:
  - (a) Stocks.
  - (b) Bonds.
  - (c) Notes.
  - (d) Advances.
- Other Investments:
  - (a) Stocks.
  - (b) Bonds.
  - (c) Notes.
  - (d) Advances.
  - (e) Miscellaneous.

Total

Current Assets:
- Cash.
  - Special Deposits:
  - Total book assets at date. (In short column).
  - Carrier's own issues at date. (In short column).
  - Other assets at date. (In long column.)
  - Loans and notes receivable.
- Miscellaneous accounts receivable.
- Material and supplies.
- Interest dividends, and rents receivable.
- Other current assets.

Total

Deferred Assets:
- Insurance and other funds:
  - Total book assets at date. (In short column).
  - Carrier's own issues at date. (In short column).
  - Other assets at date. (In long column).
- Other deferred assets.

Total

Unadjusted Debits:
- Rents and insurance premiums paid in advance.
- Discount on capital stock.
- Discount on funded debt.
- Property abandoned chargeable to operating expenses.
- Other unadjusted debits.
- Securities issued or assumed—Unpledged. (in short column).
- Securities issued or assumed—Unpledged. (In short column).

Total

Liabilities—

Stock:
- Capital Stock:
  - Book liability at date. (In short column).
  - Held by or for carrier at date. (In short column).
  - Actually outstanding at date. (In long column).
- Stock liability for conversion.
- Premium on capital stock

Total

Governmental Grants:
- Grants in aid of construction.

Long-Term Debt:
- Funded Debt Unmatured:
- Book liability at date. (In short column).
- Held by or for carrier at date. (In short column).
  - Actually outstanding at date. (In long column).
- Receivers certificates.
- Non-negotiable debt to affiliated companies:
  - (a) Notes.
  - (b) Open accounts.

Total

Current Liabilities:
- Loans and notes payable.
- Audited accounts and wages payable.
- Miscellaneous accounts payable.
- Matured interest, dividends and rents unpaid.
- Matured funded debt unpaid.
- Accrued interest, dividends, and rents payable.
- Other current liabilities.

Total

Deferred Liabilities:
- Liability for provident funds.
- Other deferred liabilities.

Total

Unadjusted Credits:
- Tax liability.
- Premium on funded debt.
- Insurance and casualty reserves.
- Operating reserves.
- Accrued depreciation—Road and equipment.
- Reserve for amortization of franchises.
- Accrued depreciation—Miscellaneous physical property.
- Other unadjusted credits.

Total

Corporate Surplus:
- Additions to property through surplus.
- Funded debt retired through surplus.
- Sinking fund reserves.
- Miscellaneous fund reserves.
- Profit and loss—Balance.

Total

The committee, in the limited time at its disposal, has been unable to make any further comparison of these classifications. We find that few of the accountants of operating companies are familiar with the classification of accounts as prescribed by the National Electric Light Association.

In addition to the lack of uniformity your committee finds these classifications are inconsistent in themselves. For example the California Classification requires the segregation of earnings as follows:

Municipal Street Lighting—Arc,
" " " —Incandescent,
" " " —Miscellaneous,
" Power,
Commercial Lighting—Flat Rate,
" " —Metered,
" Power —Flat Rate,
" " —Metered,
Railway Power,
Other Electric Corporations,

followed by the other earning accounts. Earnings are so reported on the annual report of the commission. In contrast with this in reporting the statistical data, the sales for the year in kw.-hr. are requested to be segregated as follows:

Residence Lighting,	Industrial Power,
Commercial Lighting,	Agricultural Power,
Municipal Lighting,	All Other Power.
All Other Lighting,	

Other inconsistencies exist which might be pointed out if time permitted.

The committee also finds that a comparison of reports made by different corporations doing business under the same classification often shows such a wide variance that it is almost impossible to make a just comparison between the various accounts unless some additional information is given showing what has been included. We believe that this condition arises from the different interpretations given by operating accountants to the instructions covering the use of the various accounts. One purpose of an accounting committee is to try to remedy this, and it can be accomplished through the interchange of ideas by the different accountants. There are many differences in the accounting detail practiced by the member companies, particular reference being made to the various methods used in distributing the several clearing accounts, due to different instructions issued covering the accounting detail, which instructions are not specifically laid down in the classification, but are left to the discretion of the operating accountants. Uniformity in this regard can be obtained by the numbers through interchange of ideas.

The foregoing covers, in a general way, the conditions as they now exist, and following are a few suggestions as to what should be done in the future.

Sub-committees should be appointed, similar in every way to those formed by the parent association. The committees of the Pacific Coast Section should at all times, and in every way, co-operate with like committees of the parent body, as in this way only will it be possible to obtain national uniformity, which should be the object of all accounting committees.

The committee on Uniform Classification of Accounts appointed by the National Association is hard at work on a proposed uniform classification. This committee has secured copies of the classifications prescribed by all state commissions, as well as the classifications of the National Electric Light Association and the Interstate Commerce Commission, and is at work preparing therefrom a proposed standard classification. The committee is going into this work in a very thorough and systematic manner. When completed this classification will, no doubt, be as near perfect as it is possible to make it, and its universal adoption should be strongly urged. At least a balance sheet can be made uniform and we recommend that this be done. The accounting committee should keep in close touch with all states not now under control of commissions and when these commissions are given the control of public lighting utilities, request should be made that these commissions adopt at least the standard balance sheet.

The balance sheet is the portion of a report to which investors give the most study and comparison.

The various accounting committees will be a great help to all members of the Section. Member accountants can and should submit to these committees any criticism they may have to offer affecting the classifications under which they are operating. These committees should then in turn make suggestions to the state commissions towards improving the classifications. We believe the commissions will gladly receive any reasonable suggestions and co-operate in rectifying any existing inconsistencies. All member accountants should read the association's bulletin. If one intends to get good from the association, one must put something into it. We advise all accountants to make a study of the various questions asked in the question box pertaining to accounting. We find that the larger the company, the farther away from the detailed accounting operations is the officer in charge of the accounts. Sometimes it is surprising to learn how little the accounting officer knows of the detail work being performed. Answering the questions asked in the bulletin will cause the study of one's own accounting conditions and often point out the need of improvement. In reading the bulletin one notes that nearly all questions and answers are asked and given by the same few men. We cannot too strongly urge member accountants to read and study the bulletin, and from this, if from no other source, will a uniform practice eventually be realized. We also suggest and advise accounting officers to interest the men in the more responsible positions under them, to take the new educational courses in electric utility accounting offered by the accounting section of the National Electric Light Association, as this study will be of great benefit to themselves, as well as to the companies they represent.

We repeat—the crying need is uniformity. There is lots of hard work ahead for the accounting committees to do and the work should go on with enthusiasm and dispatch.

Respectfully submitted,

B. T. Story, chairman; M. B. Fowler, W. E. Houghton, C. E. Mynard, W. J. Driscoll, B. B. Stith, C. E. Twogood, W. E. Shaw, Jr, A. C. Johnson, accounting committee.

FUEL OIL AND STEAM ENGINEERING

(Steam turbine operation on the Pacific Coast occupies a unique position in central station practice. Due to the character of the load and the fluctuating supply of hydroelectric power in the mountains, many fine points in the evolution of steam auxiliary operation have been brought to life during recent years. Here is an article by the superintendent of generation and transmission for the Pacific Light & Power Corporation, in whose system is the well-known Redondo power plant. This paper has been prepared for consideration at the Pacific Coast Section Convention of N.E.L.A. at Riverside.—The Editor.)

OPERATION OF A STEAM TURBINE STATION

BY DON D. MORGAN

Plant Equipment

The Redondo plant of the Pacific Light & Power Corporation consists of five prime movers, two 15,000 k.v.a. General Electric vertical turbines, and three 5000 k.v.a. McIntosh & Seymour double horizontal-vertical cross compound reciprocating units, four 75 kw. reciprocating and one 100 kw. turbine driven exciter units, three 30,000 gal. 30 in. centrifugal circulating pumps, each driven by a 450 h.p. tandem compound engine. There are 18 Babcock & Wilcox and 18 Stirling water tube boilers, of 604 b.h.p each, operating at 175 lb. gauge pressure and 125 deg. F. superheat, making a total of 21744 b.h.p. at rating. The boilers are capable of developing 100 per cent over rating. There are five 6 in. tandem compound duplex boiler feed water pumps, one 1000 gal. and one 1600 gal. centrifugal boiler feed pumps, the centrifugal pumps being driven by a 250 and 375 h.p. steam turbine respectively.

Normal Operation

When the plant is in normal operation:

The average daily output is 600,000 kw.-hr.

The average daily fuel oil consumption is 2600 bbls.

The average daily peak load is 40,000 kw.

The average daily efficiency is 230 kw.hr. per barrel of oil.

The average number of boilers fired for a peak of 40,000 is 34; two boilers are usually out of service for cleaning, repairing and so forth.

When plant is in full operation about 75,000 gals. per min. of circulating water is required for condensing purposes to maintain a vacuum of 28.75 in. on turbines and 27.5 in. on reciprocating engines. Ocean water is used for condensing and is obtained by means of three 54 in. pipe lines running 800 ft. out over the sea on a concrete pier, each pipe line having seven 26 in. drop pipes submerged in from 14 to 16 ft. of water. The water is siphoned into a settling chamber for the purpose of eliminating the sand and sea weed, of which there is more or less floating at all times; from here the circulating pumps lift the water from 8 to 15 ft. according to the height of the tide and it is put through the condensers under a head of 12 ft. at a distance of 400 ft. from the pumps.

Standby Operation

Under standby conditions the plant is kept in readiness to pick up 5000 to 6000 kw. as soon as a turbine can be brought up to speed, the average time required being about five minutes, although they have been brought up in three and one-half minutes, which can be done with safety if turbine has not been out of operation too long. The operating force is from 40 to 43 men.

Step bearing and guide bearing pumps are kept in motion at all times, also one of the engine-driven exciters. This is done to keep the apparatus warm and free from water and to facilitate rapid starting.

The engine room force under standby conditions is the same as under operating conditions, with the exception of the reciprocating engine oilers. The boiler room operating force is about one-third what it is under operating conditions, boiler cleaners, repair men and so forth becoming firemen and water tenders when the plant is started up.

In the event of trouble on the system of sufficient magnitude to drop the speed and voltage to zero or 10% below normal and it does not immediately come up, the operator on duty blows a signal whistle which is heard all over the plant. This signal starts the first turbine and auxiliaries and all men on duty at the time drop whatever they may be doing and take their operating stations in the engine room and boiler room. Fires are immediately started under the 18 boilers that are up to pressure and as soon as the electrical operator on duty is advised by the despatcher regarding the requirements, all the other boilers are fired, if needed, except those that may be out for cleaning or repairs, as a rule not over three. If it is known that the entire plant will be required to operate for any length of time, the steam siren is blown, calling all men off duty to the plant.

Boilers Up to Pressure

Under standby conditions, 18 boilers are kept up to pressure and ready to fire at all times. This is done as follows: It requires nearly full capacity of one boiler at all times to supply steam for the auxiliaries and take care of the losses in steam piping due to condensation. The 18 boilers that are kept up to pressure are fired one at a time, about 2 hours each, in regular sequence. By this means the last few boilers fired are hot enough to generate steam as soon as the fires are lighted and the others will commence to deliver steam in proportion to the time since they were last fired. All dampers and doors on all boilers, except the one being fired and those out for repairs, are kept tightly closed. The fuel oil is kept at a temperature of 180 deg. and circulated by the pumps through the heaters, burner lines and back through the burning tank. Under these conditions and when the plant is strictly on standby the fuel requirements are about 110 barrels of oil per day.

It is possible with this arrangement to pick up about 5000 kw. in five minutes (or by time turbine is

cut in) and 1000 kw. each minute up to 15,000 kw., or 15,000 kw. in 15 minutes, and both turbines on up to full load, 30,000 kw. in 25 minutes.

Boilers at Atmospheric Pressure

Fifteen to seventeen of the 18 Stirling boilers (depending on the number out for repairs or cleaning), are kept full of water from 150 deg. to 175 deg. F. The water is kept at this temperature by using the overflow from the Cochrane feed water heaters. Under standby conditions the exhaust steam from the plant auxiliaries is more than sufficient to heat the small amount of feed water required.

The overflow from the heaters to the hot well is picked up and circulated through the boilers and returned to the hot well where it is pumped into the heaters by means of a float-regulated make-up pump. These boilers are not under pressure and keeping them at this temperature not only makes it possible to fire them up and have them generating in less than 30 minutes, but helps to keep down corrosion.

The hot water circulating system for these boilers is entirely independent of the feed water system. It consists of a low pressure reciprocating pump run at the proper speed to keep the required water level in the boilers, and connects to the boilers by means of 4 in. headers and 1½ in. pipe connections to the mud drums. The gravity return is from the middle drum through a similar piping arrangement. Check valves are provided at each mud drum connection and the gravity return from the boilers is taken care of by manually operated valves controlled from the boiler room floor. This arrangement, after about one year's try out, has proven entirely satisfactory and we believe is nearly, if not quite fool proof. This arrangement saves about 12 barrels of oil per day over the previous method of occasionally firing up these boilers, which required about 3 barrels of oil to the boiler.

A load of 44,000 kw. has been picked up in 46 minutes after emergency signal had been blown with 34 boilers in service.

Engine Room

In the engine room it is found necessary to warm up the reciprocating engines twice each week. They are brought up to speed but not cut in. The engines on the circulating pumps are brought up to speed every day, due to the 400 ft. of steam line supplying them. Due to load conditions it is necessary to float one of the turbines from two to two and one-half hours per day. The two turbines are alternated in this service. The turbine is brought up to speed and synchronized in the usual way but given only sufficient steam to maintain minimum temperature of turbine blading, the wattmeters on the generator loads reading approximately zero. This is accomplished by adjusting the governor so that it will not operate unless the speed drops about 5 per cent, and admitting steam to the turbine by means of a hand regulated valve at the first nozzle valve. As the purpose of floating the turbine on the line is to make use of the generator as a condenser, tests were made to determine the minimum amount of steam required to prevent excessive heating of the blading.

Testing Turbine Generator as Condenser

These tests were made by bringing the turbine up to speed and synchronizing in the usual way with the vacuum pump in normal operation. Temperatures were taken by means of Fahrenheit thermometers in the first, second, third and fourth stages and the condenser base. Electrical readings were also taken at the same time. Below is given a few of the readings which are typical of the various conditions:

Temperature Turbine Stages				Cond	Vacuum		By-Pass	Electrical Measurements		
1	2	3	4	Base	Cond	Barometer	Valve Open	Cycles	Ind kw	Field
272	200	160	157	102	26.8	29.88	5/16 in.	50	0	90
258	188	158	154	104	26.6	29.86	5/16 in.	49.5	—700	200
262	200	164	166	106	26.3	29.86	5/16 in.	50.5	—200	150
280	152	113	100	93	28.6	30.0	3/16 in.	50.0	0	210
258	204	155	146	100	27.0	29.96	3/16 in.	50.0	—200	150
260	197	158	169	102	27.2	29.96	3/16 in.	50.0	—1000	195
271	158	131	128	130	28.1	29.6	3/4 in.	No readings taken.		
276	159	126	124	126	28.2	29.92	3/4 in.	No readings taken.		
272	157	128	124	128	28.2	29.96	3/4 in.	No readings taken.		

The readings obtained were sometimes very inconsistent. Observations were made covering several days on the various by-pass openings. At the time these tests were made the 3/16 in. by-pass opening was decided upon as the minimum opening for this condition of operation, the temperatures going up if a smaller opening was used.

"By-Pass" Valve

The "by-pass" valve, so called, is an alteration in the first 3½ in. nozzle valve supplied with the turbine by the manufacturer, in which the regular stem is removed and a threaded valve stem with hand wheel is installed in its place. This arrangement makes the valve non-operative by the turbine governor. Each turbine is overspeeded once a week to insure the satisfactory operation of the overspeed tripping device.

Condenser Water

Water for the condenser is supplied by an 8 in. centrifugal pump delivering water through the regular salt water line to the condenser. A butterfly valve is installed in the 36 in. discharge line from the condenser, which is kept closed at all times while turbine is acting as an electrical condenser. The valve is manually operated by a worm gear. A 10 in. outlet is provided to remove the hot water from the top of the condenser. Fresh water is kept in the reciprocating engine condensers to prevent tube packing from drying out and to prevent corrosion.

Fuel Oil

Under present operating conditions an average of about 140 bbl. of fuel oil is required for daily operation. This takes care of the warming up of apparatus and the operation of the turbine driven generator used as a condenser from two to three hours per day. The use of the generator as a condenser requires about four barrels of additional oil per hour for the turbine and its auxiliaries.

Dry Out of 18,000 Volt Generators

The 5000 kw. 18,000 volt generators direct connected to the reciprocating engines are kept on an electrical dryout, due to the atmospheric conditions so close to the ocean. This is accomplished by a.c. current from the station auxiliary transformers. Each generator is supplied with about 200 amps. at 440 volts, single-phase, to the 18,000 volt generator leads, through disconnecting switches so arranged that it is impossible to connect generator to the high tension busses until the dryout connection is opened.

The armature windings are connected "star" with the neutral grounded and while on dry out, the 400 volt current is applied by connecting two generator terminals to one side of the 440 volt circuit and one to the other. While this arrangement does not give an equal amount of current in each phase winding it was found to be suitable for the voltage available and provided sufficient heat to keep the windings dry without an excess of current in any one winding.

The temperature of the windings varies according to atmospheric conditions and ranges between 35 deg. and 46 deg. C. About 500 kw.-hr. per day per generator is required for this purpose. As there are three of the 18,000 volt generators on this dry out, the load on each phase of the station auxiliary transformers is fairly well balanced.

Standby Maintenance

In general, considerable trouble is experienced, due to leaky valves and flanges, and more or less trouble on account of corrosion. Trouble with the superheaters has been eliminated to a considerable extent by providing drips from them to the regular drip system. All main and auxiliary steam lines are taken care of in a like manner and the drips are piped to a centrally located separator and returned to the boiler feed-water line. The principal maintenace is taking care of leaky piping and valves due to temperature variations and corrosion.

Emergency operation under standby conditions is very inefficient, due to lack of experience of the men who are called in to do the work for only short periods at infrequent intervals.

Such changes as have been made from time to time in the steam department, on account of the standby conditions, have been brought about by degrees, due to the small operating force, and mostly have been devised and installed by a very competent and conscientious chief engineer to whom the writer of this paper is considerably indebted for the information contained therein.

PROGRESS ON PROTECTION OF OIL FIELDS

The first annual report, covering the work of the California State Mining Bureau in protecting California oil fields from infiltrating water, has just been published and is ready for distribution. The public is interested in the protection of the oil fields owing to the widespread use and importance of petroleum; and the operators who have their money invested in the oil fields are directly concerned in seeing their property protected from damage caused by careless and inefficient drilling methods, which have been little short of universal. The distribution of the report will be helpful at the present time, as some amendments to the law are now before the legislature, and a thorough public knowledge of the facts is necessary.

HIGH COSTS AFFECT ELECTRICAL INDUSTRY IN CHINA

The abnormal situation in the Japanese coal market arising from the greatly increased demand there for fuel for industrial plants, and the diversion of mining labor into better-paid channels, is now reflected in China, largely as a result of the scarcity of shipping. The central and southern parts of the country are particularly affected. In Shanghai prices are about 30 per cent higher that last year, and it is possible that they have not yet reached a maximum.

The municipal electricity department, which is a a very large purchaser, has been paying so much more than usual that it is becoming a question whether it can continue the low rates for current for industrial purposes that have been an important factor in the recent growth of manufacturing plants in Shanghai.

ELECTRICAL CONDUIT IN NEW ZEALAND

Jobbers and importers in New Zealand have experienced difficulties recently in obtaining enough electrical conduit to meet their needs from the usual sources in England. They are interested in American sources of supply and have asked about the possibility of manufacturers in the United States, making conduits in accordance with the local standards, with the object of meeting the demands of this market.

Brazed or welded heavy-gauge conduit is commonly used, made up with screwed, or as we term it, threaded joints. The North Island has a wider use for the brazed joint, while in the South Island the welded is more popular. There is also some use of the open joint with slip or grip fittings.

CAUSE OF DELAY IN N. E. L. A. PUBLICATION

April 2, 1917.

Sir:

In regard to the Meterman's Handbook, we would say in explanation of the delay, that we are becoming considerably embarrassed on account of the difficulty if not the impossibility of securing the paper with which to print this book. It is a special high grade of light weight paper made by relatively few mills; and the three mills to which we applied first for paper, absolutely declined to take our order. At this moment, we have succeeded in closing with a fourth mill and are hopeful that we may have the paper delivered to us in a couple of weeks, but as to this we have no guarantee.

We should also like to state that at last we have just received the new edition of the Overhead Line Construction Handbook, which will be issued immediately. We are in the class with all other purchasers of apparatus and material in these days, subject to many months of delay which seems unavoidable.

We are now only waiting for the covers of the Salesman's Handbook of which we are promised delivery in about 3 weeks and copies will be mailed shortly after.

T. C. MARTIN, Secretary.

SPARKS—Current Facts, Figures and Fancy

(Notations on recent evolution in Eastern central station practice are always interesting to engineers of the West. The progress of legislation on water power development, too, is always followed with keenest attention. These matters, together with other jottings that will give you ideas and inspiration for future effort are discussed briefly in the following lines.—The Editor.)

The average passenger train earns, for carrying passengers, mail, express and parcel post, about one dollar forty cents per mile.

* * *

Forty per cent of the United States has now been mapped by the United States Geological Survey with topographic sheets. Over fifteen million dollars have been spent on this work, covering a period of nearly forty years.

* * *

A good proverb to bear in mind at all times says: "Whoever wishes to study with success must exercise himself in these three things: In getting clear views of a subject; in fixing in his memory what he has understood; and in producing something from his own resources."

* * *

In the General Grant National Park in central California, there are more than twelve thousand sequoia trees exceeding ten feet in diameter, seven of the largest range from twenty-seven to thirty-six and one-half feet in diameter, and in height from two hundred fifty-five to two hundred ninety-two feet.

* * *

Orville Wright, the noted aeroplane inventor, sees ahead a new transportation problem to be solved in the evolution of the aeroplane as a use in transporting gold. Especially does he see by this means a new and hitherto unrivaled development for Alaska in her inaccessible, but rich mineral districts.

* * *

That mine timbers of white spruce, Sitka spruce, white birch, and western hemlock grown on the Chugach National Forest, Alaska, are fully as good as Douglas fir from the Rocky Mountain region and are superior to other Rocky Mountain species for use as mine timbers has been demonstrated by the Forest Products Laboratory at Madison, Wis.

* * *

According to the recent annual report of the American Telephone & Telegraph Company there are now nearly twenty million miles of wire in operation of telephones. This is almost sufficient in length to connect us up to Mars at the proper season of the year in order to enquire about the possible use of electrical pumps on the famous canals said to exist there.

* * *

In only one case out of nearly ninety thousand operations have the automatic electric block signals of the Southern Pacific, on the average, failed to give proper indication to the engineer in the cab. By failure is not that the engineer was not warned of danger, but rather that he was held back when the track was clear. Such are the wonders of modern electric genius.

Frank Trumbull, chairman of the railway executives advisory committee, states that if you should write a letter to any American railroad official, his company will have to haul a ton of freight—two thousand pounds of average freight—coal, ore, silks, ostrich feathers and everything—for more than two and one-half miles to get enough money to buy a postage stamp to send you an answer.

* * *

As an example of the lack of progress along electro-chemical lines in America, it is pointed out that open-hearth furnaces are as yet the prevailing type in this country, yet by the use of the more modern closed hearth type, as much fixed nitrogen could be saved as is now needed for all the ammunition for all the armies now at war, and enough coal tar to meet the needs of the whole world in the making of dye-stuffs and medical substances.

* * *

The general dam bill, one of the water-power measures before Congress, was killed for the session by a hopeless disagreement of conferees, who were unable to reconcile differences between the House of Representatives and the Senate provisions. It is hoped that hydroelectric development will come into its own in the near future and cease to be hampered by dilatory tactics at Washington.

* * *

Indicative of Eastern evolution in central station practice, the recent changes in policy of the Edison Electric Illuminating Company of Brooklyn are interesting. Discontinuance of the free supply and renewal of incandescent lamps has been made; carbon or gem lamps are no longer kept in stock; Mazda lamps are used exclusively; and on original installations of lamps for any customer, the company will permit the customer, if he desires, to pay in monthly installments along with the bills for current.

* * *

In co-operation with the Department of Psychology of the University of Wisconsin, the Forest Service has made a study to determine the effect of color of paper and of glare upon eye fatigue. Some original and interesting methods of testing eye fatigue were developed. These studies showed that practically no difference in eye fatigue was produced by reading from newsprint paper manufactured from tamarack as compared with that from spruce. From the standpoint of ease of reading there is no valid objection to newsprint paper made from woods such as tamarack which produce darker colored papers.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Act of Congress of August 24, 1912, of "Journal of Electricity," published semi-monthly at San Francisco, California, for April 1, 1917.

State of California,
County of San Francisco—ss.

Before me, a notary in and for the state and county aforesaid, personally appeared E. B. Strong, who, having been duly sworn according to law, deposes and says that he is the president and business manager of the "Journal of Electricity," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Names of	Post Office Address.
Publisher, Technical Publishing Company	No. 6 Crossley Bldg., San Francisco
Editor, Robert Sibley	No. 6 Crossley Bldg., San Francisco
Managing Editor, A. H. Halloran	No. 6 Crossley Bldg., San Francisco
President and Business Manager, E. B. Strong	No. 6 Crossley Bldg., San Francisco

2. That the owners are: (Give names and addresses of individual owners, or if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

E. B. Strong	San Rafael, Cal.
R. J. Davis	Berkeley, Cal.
A. H. Halloran	No. 6 Crossley Bldg., San Francisco
C. L. Cory	Nevada Bank Bldg., San Francisco
Robt. Sibley	Berkeley, Cal.
Mrs. L. B. Storey	Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

E. B. STRONG, President.

Sworn to and subscribed before me this 26th day of March, 1917.

(Seal) CHARLES EDELMAN,
(My commission expires April 7, 1917.)

CONTENTS

OUR PRESENT DUTY

As engineers of the West we salute the grand old flag as a unit, bearing fully in mind the thought that it is of utmost importance throughout the present trying scene through which the nation is passing that there be an avoidance of paralysis of effort in every phase of business activity. In the mobilization of national industrial resources the part that men of the electrical industry will play can not be overestimated. The great hydroelectric resources of the West are capable of rendering untold service to the nation. Let us then proceed quietly about our daily tasks with the calm assurance that all that can possibly be done is now being properly cared for and let each stand ready to offer to the nation, immediately upon the summons, the best within him for the task required of him no matter what that demand may be.

Mobilizing the Electrical Industry

The clarion call to arms is being answered by electrical men everywhere. In the national guard, in the officers' reserve corps, and in volunteer rifle clubs men of the electrical industry are ready to serve their nation as they have been heretofore serving the electrical needs of its population. Three hundred employes of one Western central station are drilling daily on company time.

So spontaneous has been the response that the problem of raising an army for the front is already dwarfed by the necessity for effectively organizing those who are needed at home. "For every man in the field there must be one at home." The mobilization of troops is really secondary to the mobilization of the country's resources to care for them.

The farmer must till the ground and the mechanic work in the factory. This involves the government's eventually taking over all industries and making governmental necessities paramount to existing contracts with private parties. The supply of electric energy is a public necessity which will undoubtedly come under military control as serious eventualities develop.

This question will be given weighty consideration at the Riverside convention of the Pacific Coast N. E. L. A. Section. Two of its members are on the California council for defense, the electrical men of Arizona and New Mexico are deeply interested in the border situation and Nevada's representatives are fully alive to the situation. Discussion and action at the convention will be followed with keenest interest.

A Constructive Public Policy

When Alexander, the Great, sighed his soul for more worlds to conquer, it is not unbelievable to imagine that he emphatically was saying "This is the last great war." When Hannibal, in the dead of winter, led his all-conquering Carthagenian troops down from the Alps, he, too, undoubtedly whispered, "This is the last great war." When Napoleon swept the map of Europe from its former recognizable boundaries possibly in his quieter moments he may have been heard to mutter, "This is the last great war."

And so when this present generation shall witness dynasty after dynasty pass away and the conflicting world forces readjusted so that a more harmonious development of human life becomes possible, we, too, may be tempted to say in our hearts "This is the last great war." But it is well to remember through it all that the evolution of life is infinite. New problems, new ideals—each the champion of its day—must unfold as the years roll on. Hence new struggles, new combats—devoid of bloodshed or the taking of life we hope—must of necessity arise throughout all ages. Such are the demands of life and its unfoldment.

Let us then, as builders, build wisely and on such broad lines as to minimize friction and promote cooperation. A recent decision of the United States Supreme Court is far reaching in its effect upon the future harmonious development of hydroelectric power throughout the West. Briefly, the Supreme Court has ruled that until further legislation is enacted hydroelectric power companies are denied fee title to rights-of-way over government land and are restricted in the use of such rights-of-way as may be granted so that these become mere leases or easements issued by the Department of the Interior or Agriculture.

Such a state of affairs is indeed most deplorable. The West is urgently in need of continued water power development. The high cost of fuel makes such development a necessary adjunct for practically every phase of civic, domestic and industrial growth.

The time for bickerings and petty quibbles has long since passed away. This country is now united heart and soul for unified and harmonious action. Reasonable legislation should be passed at the earliest date possible to stabilize this necessary unit in our present mobilization of national resources.

The Last Word from the Canal

The great slide at the Culebra cut in the Panama Canal which occurred during the Panama-Pacific International Exposition at San Francisco, caused much gossip and many forebodings throughout the civilized world as to the possible future usefulness of this great waterway. Especially was the comment in certain of the foreign press of an unusually pessimistic tone.

The gathering of engineers at the San Francisco Engineers' Club recently in honor of the return of three noted American scientists and engineers from a tour of the Orient was more than gratified to hear a most encouraging word from one member of the party who has recently served upon a commission of noted geologists, physicists and engineers appointed by the President to investigate the possibility of a future occurrence of the incident.

It was stated that the report of this commission, composed of the most eminent specialists the world has produced, is unanimous in its verdict that the canal will in the future remain open, that serious slides are a thing of the past, and that such slides as may occur at rare intervals will be only a matter of a day or a week at the most for their proper disposal.

Traffic reports show that shipping has practically resumed its normal rating and that engineers and commercial bodies of the Pacific area can again rejoice in anticipating that this unprecedented engineering feat will bring about, as the years roll by, the much-heralded fruits of friendly and economic commercial intercourse with all the great shipping channels of the world.

Scandalous Neglect of Vehicle Load

That the electric passenger car and especially the electric truck offer untold opportunities for increased profitable power consumption in central stations of the West is the conviction to which close watchers of evolution in vehicle design are fast coming.

The eyes of the public have been so totally blinded by the fascinating and overpowering publicity campaign of the gas operated car that central station managers have evidently overlooked almost with scandalous neglect the possible fruitful results that await the careful nurturing of this most desirable off-peak load.

A close similarity in the almost total abandonment of this nurturing on the part of the central station may be drawn to the happenings in the days of Sir Isaac Newton. This great scientist had so dazzled the scientific and business world with his famous logic and inventions that the very expression of an opinion on his part had for reaching consequences. He stated that refracting telescopes could never be made to correct for the dispersion of light rays of different color or wave length, consequently the entire world abandoned for fifty years the use of refractive telescopes and adopted the cumbersome reflectors thus setting back the development of the wonders of astronomy for a half century.

And so in case of the gas-operated car, the argument of superior speed and distance has been used so effectively against the electric vehicle by the gigantic publicity of the manufacturers of gas-operated cars that the electric truck has had a severe struggle for existence and the electric passenger vehicle has almost passed out from use in the West.

A new awakening is now upon us. The splendid highways throughout the West with their easy access to electric service on all sides augur well for future activity of the electric vehicle in the country. And in the city the unquestioned superiority of the electric vehicle in practically every count offer for the progressive power sales manager an unusual opportunity for creating a gigantic off-peak load that will tend much, as years roll on to stabilize the fluctuating load factors now experienced in hydroelectric practice.

PERSONALS

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has added another honor to his long list of valuable services to the public. Mr. Britton has been appointed by the Governor of California as a member of the California State Defense Board along with a distinguished array of the greatest business and executive talent that California has produced. As the hydroelectric activities of the state will undoubtedly have a far reaching influence in every phase of national defense his appointment is indeed gratifying to all members of the electrical industry.

Chas. H. Spinks, in charge of construction for the Hetch Hetchy Railroad, is a recent San Francisco visitor.

B. G. McDougall, manager of the Manhattan Electric Supply Company, is at Portland, Ore., from New York City.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, is spending several months in the East.

Hal Lauritzen, Holophane salesman of the Pacific States Electric Company, has returned to San Francisco from an Eastern trip.

H. B. Squires of the H. B. Squires Company of San Francisco, is on a business trip throughout the East to be absent about thirty days.

Tracy E. Bibbins, president of the Pacific States Electric Company, after an absence of several weeks, is again in his San Francisco office.

C. E. Groesbeck, vice-president and general manager of the Utah Power & Light Company, has returned to Salt Lake City from Los Angeles.

W. S. Berry, sales manager of the Western Electric Company, has returned to San Francisco from a seven weeks' sojourn in the Hawaiian Islands.

M. L. Joslyn, of the Baker-Joslyn Company, is visiting the San Francisco office on his return trip East after a delightful visit to the Hawaiian Islands.

Carl Heise, Pacific Coast manager for the Westinghouse Electric & Manufacturing Company, has left San Francisco for a three weeks' sojourn in the Hawaiian Islands.

E. D. Pike, of the Wagner Electric Manufacturing Company, San Francisco, has left for the East to attend the Sales Managers' Convention of his company at St. Louis.

J. M. Barry has resigned as chief of the San Francisco Department of Electricity to become engineer of distribution for the Great Western Power Company at San Francisco. **Arthur Kempston** succeeds Mr. Barry as chief.

L. A. Wright has been appointed local manager of the San Diego Consolidated Gas & Electric Company at Escondido, Cal., to have charge of the gas and electric utilities in that district recently taken over by the company for operation.

Edward Whaley has recently been appointed general agent for the Northern California Power Company, Cons., in addition to his duties as secretary. He will actively direct the commercial and public policy of the organization, maintaining his offices at San Francisco.

Henry Bostwick, formerly secretary to the president of the Pacific Gas & Electric Company, has been promoted to the position of assistant to the first vice-president. Mr. Bostwick, who is well known to the electrical fraternity throughout the West, is the recipient of congratulations from all quarters.

E. B. Strong, Jr., treasurer of the Technical Publishing Company, publishers of the Journal of Electricity, is now with Company D of the Fifth Regiment, National Guard of California, and is just in receipt of a commission from President Wilson promoting him to the rank of second lieutenant.

George C. Mason of the Hurley-Mason Company, has been appointed by the civic committee of the Realty Board in Portland to make a thorough investigation of the plans for the proposed municipal lighting plant. Mr. Mason estimates that the work of checking will take from two to three weeks.

Edward West, formerly efficiency engineer for the Portland Railway, Light & Power Company, but now chief engineer at Denver, Colo., for the Denver Tramway Company, is back in Portland for a few days, as a result of the serious illness of his father, H. G. West, employed by the Portland Railway, Light & Power Company.

John A. Brashear, educator and manufacturer of astronomical and physical instruments; **Ambrose Swasey**, president of The Warner & Swasey Company of Cleveland, Ohio, and **John R. Freeman**, the well-known hydraulic engineer, are recent San Francisco visitors who have just returned from a four months' tour of the Orient.

Leonard Lundgren, district engineer of the United States Forest Service in Portland, has been designated as ordnance officer for the coast defense command of Oregon. This position entails accountability for all ordnance property, armament and equipment of the Oregon coast defense, and the inspection of all such property at least once each month.

C. I. Kephart and **Kenneth V. Laird**, formerly of California, are now at Anaconda, Montana. Mr. Kephart is valuation engineer in charge of a party for the Interstate Commerce Commission, and has been handling the valuation of the Butte, Anaconda & Pacific Railroad, the pioneer 2400 volt d.c. electrified road in the United States. Mr. Laird is operating the Cottrell flue gas treater for the Anaconda Mining Company at the Washoe smelter.

F. O. Broili, industrial engineer of the Northwestern Electric Company, Portland, Oregon, was the guest of honor at a luncheon held at noon, March 30th, at the Hazelwood restaurant. The occasion of the honorary luncheon was the fact that Mr. Broili is leaving the employ of the Northwestern Electric Company to accept the position of president and engineer of the Nevada Machinery & Electric Company, Reno, Nevada, as announced in the issue of the Journal for April 1. The employes of the Northwestern Electric Company, including the engineering, operating, commercial, auditing and purchasing departments, made up the guests invited.

William B. Burbeck, engineering works, sales department, Pacific Gas & Electric Company, San Francisco; **Walter John Delehanty**, construction foreman, Pacific Coast District, General Electric Company, San Francisco; **Robert Sindorf Ferguson**, instructor in mathematics and electrical laboratory, Throop College of Technology, Pasadena; **Otis Gibson**, civil engineer, Keystone Dredging Company, San Francisco; **Jesse Russell Himmelsbach**, student, University of Washington, Seattle; **Joseph Earl Kettlewell**, power plant foreman, Yukon Gold Company, Iditarod, Alaska; **Edgar George List**, maintenance engineer, Utah Power & Light Company, Olmsted, via Provo, Utah; **Charles Alexander Mendenhall**, telegraph and telephone engineer, Interstate Commerce Commission, San Francisco; **Clyde Pattee**, plant department, Oregon-Washington Telephone Company, Hood River, Ore.; **Alexis Joseph Reed**, engineer, equipment department, Pacific Telephone & Telegraph Company, San Francisco, have been elected associates of the American Institute of Electrical Engineers.

MEETING NOTICES FOR ELECTRICAL MEN

(War and military preparedness occupy in a marked degree the discussions in practically all the gatherings of the past two-week period. Especially has discussion leading toward training men for the Engineers' Reserve Officers Corps been most marked. In spite of this war talk, however, effective planning for conventions and electrical gatherings of the year still grow apace, for it is generally realized that mobilization of industrial strength of the nation can be vastly aided by such gatherings and discussions and as a consequence that these gatherings should be held come what will, what may. —The Editor.)

San Francisco Engineers' Club

The luncheon talk for the San Francisco Engineers' Club on March 29, 1917 was given over to a consideration of co-operative organization and how it is applied. The speaker of the day, A. B. C. Dohrmann, was introduced by N. A. Bowers. Forceful incidents were recounted by the speaker in the course of his address as to how co-operation in certain of the mercantile industries of San Francisco and vicinity has worked wonders in putting that particular business an a firm footing. The speaker concluded by saying that true co-operation assisted all in a particular industry to find the true aim desired, then how to go about attaining and finally bringing about the ultimate aim in view.

A luncheon on April 3 was given at the club rooms in honor of Dr. John A. Brashear, Ambrose Swasey and John R. Freeman who have recently completed a four months' tour of the Orient. Geo. W. Dickie, the well-known consulting naval architect, acted as chairman. The luncheon was the most widely attended gathering of the year and the interesting impromptu remarks of the three guests were listened to with unusual attention.

Los Angeles Jovian Electric League

March 28th was Military Day at the regular Wednesday luncheon and several inspiring and impressive addresses were given by prominent army officers. Measures of preparation for national defense were also discussed. Upon the motion of R. H. Ballard, it was unanimously decided that all members should take up with their respective companies the matter of giving their approval to all enlisting employes, and of keeping their positions open until their return. Dr. Charles W. Decker, major of field medical corps, acted as chairman of the day, and after a brief address he introduced Charles F. Hutchins, Colonel Seventh Infantry, C. N. G., whose subject was "Military Possibilities in Los Angeles." He was followed by W. L. Moreland, manager of the Moreland Truck Company, who spoke on "Highways and Motor Vehicles in Pacific Coast Defenses," and Mr. H. B. Light, Colonel of Artillery Reserve, whose topic was "Fort MacArthur."

The meeting for April 4 was under the chairmanship of Harry G. Holabird, manager of the Holabird Electric Company. The speaker Thomas Lee, Woolwine, district attorney for the county of Los Angeles, spoke interestingly and instructively of the work in the district attorney's office.

BUILDERS OF THE WEST—III

R. H. BALLARD

The younger generation is fast making itself felt in engineering of the West. From all sections of the West are emanating ideas in constructive engineering methods that are daily serving as patterns for the central station activity of a nation. To R. H. Ballard, assistant general manager of the Southern California Edison Company and president of the Pacific Coast Section of the National Electric Light Association, this issue of the Journal is affectionately dedicated in recognition of his splendid ideals in comradery not only instilled among the men of his company, but among all with whom he comes in contact.

Joint Meeting of Portland Sections of A.I.E.E. and N.E.L.A. With the Oregon Society of Engineers

The bi-weekly luncheon of the joint local sections of A.I.E.E. and N.E.L.A. and the Oregon Society of Engineers was held Wednesday noon, March 28, at the Oregon Hotel, Portland, Oregon.

The luncheon was in charge of the Westinghouse Electric & Manufacturing Company with C. L. Wernicke as chairman of the day.

The speaker of the day was A. G. Labbe, vice-president of the Willamette Iron & Steel Works, whose subject was "Some of the Features of the Proposed Anti-Picket Law." The attendance was forty.

The Southwestern Electrical & Gas Association

The thirteenth annual convention of the Southwestern Electrical & Gas Association will be held in the Adolphus Hotel, Dallas, Texas, April 26-28, 1917.

The registration bureau and secretary's desk will be located in the lobby of the Adolphus Hotel, close to the hotel office. As soon as members, visitors or guests arrive or are settled in their hotels, they should at once go to the secretary's desk, register and receive their badges. This will greatly facilitate the work of the convention and will be a convenience to all other members, etc., who may be desirous of knowing of the arrival of their friends and acquaintances.

The morning of the first day of the convention, Thursday, April 26th, will be devoted to the "Opening Session," which includes the "Address of Welcome" and the response to it, the president's address, the election of new members, the appointment of the convention committees and other preliminary business. The street and interurban sessions will be held on the afternoon of that same day and the morning of the next day, Friday. The gas sessions will be held in parallel with those of the street and interurban railway sessions on Thursday and Friday, but these will be held in separate rooms. The electric light and power sessions will be held on the afternoon of the second day of the convention, Friday, and the morning of the third day, Saturday. The general session will be held early in the afternoon of Saturday. At this session will be discussed any matters of interest and value to all the members of the association. The business session will immediately follow the general session. At this session will occur the reports of the treasurer, secretary and all committees and

the nomination and election of the officers and standing committees for the ensuing year.

The papers and addresses have been selected by the several section committees of gas, electric light and power, and street and interurban railways, with special reference to the present needs of the members of their respective sections. It has been deemed best by all three of these committees to devote one of two sessions of each to practical operating subjects and the other session to executive and administrative matters and to matters of public policy.

San Francisco Electrical Development & Jovian League

The program for the luncheon talk of the San Francisco Electrical Development & Jovian League on March 28 was devoted to accident preventive and the accomplishments of the Industrial Accident Commission of California. Nathan A. Bowers, Pacific Coast representative of the McGraw Publishing Company, as chairman of the day, introduced John R. Brownell, superintendent of the commission who ably presented the effective work of his organization.

The meeting for April 4 was a most enthusiastic one. Julean Arnold, American commercial attache at Peking, China, spoke on American commercial and engineering opportunities in the great Orient. Robert Sibley, editor Journal of Electricity, acted as chairman of the day.

R. M. Alvord, the newly-elected president of the League, outlined some very constructive policies for enlivening the attendance and effectiveness of the League activities for the coming six months. His committees are as follows:

Executive Committee—C. E. Wiggin, H. H. Hoxie, H. P. Pitts, E. E. Brown.

Finance Committee—C. E. Wiggin, L. A. Newbert, M. S. Orrick, Ed. Whaley, Garnett Young.

Entertainment Committee—H. P. Pitts, A. Fulton, R. G. Guyett, L. M. Hardie, W. J. Prendergast.

Publicity Committee—A. H. Halloran.

Local Newspaper Publicity—F. S. Myrtle.

Reception and Attendance—H. H. Hoxie, W. S. Coleman, C. F. Butte, E. M. Cutting, A. E. Drendell, D. E. Harris, J. T. Littlefield, T. W. Simpson, W. F. Neiman.

Public Affairs—H. C. Reid, A. H. Elliot, C. B. Kenny, P. J. Ost, F. C. Piatt.

Wiring Specifications—Chas. J. Wilson, J. M. Barry, E. E. Brown, L. M. Hardie, H. C. Reid.

Lecture Bureau—Miles Steel, F. E. Boyd, S. V. Walton.

Educational—E. E. Brown, N. A. Bowers, W. K. Brown, Geo. Curtiss, A. R. Thompson

Membership—W. F. Neelands, T. E. Collins, R. E. Fisher, J. C. Manchester, A. Meinema, N. R. Dunbar.

On Wednesday, April 12, Dr. Josiah Sibley, pastor of the well-known Calvary Presbyterian Church, addressed the League meeting on "Making Time." W. S. Coleman of the Pacific Gas & Electric Company acted as chairman of the day. The meeting was the largest attended for many weeks past and the outlook is most encouraging for future effective work of its members.

Sacramento Engineers' Club

In the rooms of the Board of State Reclamation, Major P. M. Norboe, assistant state engineer, called together an enthusiastic group of fifty engineers on the evening of April 3, 1917. The meeting was for the purpose of forming the Sacramento Engineers' Club which was successfully accomplished and the following were elected as officers: Major P. M. Norboe, president; G. R. Winslow, vice-president; Albert Givan, secretary; board of directors, Geo. S. Nickerson, W. D. Curtis, C. H. Wildman, E. M. Mackusick and Capt. J. A. Given.

The club plans to hold regular meetings the second Tuesday of each month.

Portland Sections of A. I. E. E. and N. E. L. A.

The joint meeting of the local sections of the A. I. E. E. and N. E. L. A. was held at the Hotel Multnomah on the evening of April 3. The speaker of the evening was R. W. Mastic and the subject was "A Field Investigation of Inductive Interference in Telephone Circuits Arising from Parallelism with a 55,000 Volt Power Circuit." L. T. Merwin was chairman of the meeting and an extended oral discussion was indulged in after the paper. Forty were present.

Oregon Society of Engineers

Oregon Society of Engineers held a meeting at the Central library Thursday evening, April 5. J. W. Swaren, hydroelectric engineer with the Pelton Water Wheel Company, San Francisco, gave an informal talk on "Some Interesting and Unique Bits of Engineering Construction," which have come to his notice in the course of his practice. The talk was illustrated by means of lantern slides. J. P. Newell, presided as chairman. An amendment to the constitution was prepared authorizing the formation of chapters of the Society outside of the city of Portland. Forty were present.

Convention Electrical Supply Jobbers' Association of the Pacific Coast, April 26-28, 1917

The convention of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Del Monte, California. April 26-28, 1917.

There will be discussions, social events, golf tournaments, an open manufacturers' central station and jobbers' meeting, and the customary golf dinner. Owing to the large number of tourists at Del Monte there will not be so much room as usual, consequently the convention members must of necessity live a little closer. If you are coming send in your name at once to Albert H. Elliott so he can advise the hotel management and make the reservations. Pick out your room-mate if you can.

National Electrical Supply Jobbers' Association Convention

The ninth annual meeting of the Electrical Supply Jobbers' Association will be held at the Homestead Hotel, Hot Springs, Va., May 22-24, 1917.

BOOK REVIEW

Awakening of Business. By Edward N. Hurley. Size: 5½ by 8 in.; 240 pages. Published by Doubleday, Page & Co., of New York City, and for sale by the Technical Book Shop at San Francisco. Price $2.00.

As the author brings out in the introduction of this excellent book, we in America are in danger of forgetting that the suffering of the warring nations has rewards which in the long run may give them mastery over those nations which with self-complacency cling to ideas and methods of a passing age. America is now prosperous, but unless this period of prosperity is made a time for reorganizing the whole fabric of our business system, we shall suffer seriously in competition with European nations when they are again upon the normal business footing.

Interior Wiring. By Arthur L. Cook. Size: 4½ by 7½ in.; 416 pp.; replete with tables and illustrations; pliable binding. Published by John Wiley & Sons, Inc., of New York City and for sale at Technical Book Shop, San Francisco. Price $2.00.

This book is intended as a guide to modern practice in electric lighting and power applications, and in the design and installation of the wiring for such purposes.

There are many text-books which deal with the principles of operation of electrical apparatus and the methods of calculating electric circuits, but the usual electrical worker or the student does not possess a sufficient background of practical experience to enable him to use these principles to design a wiring installation. Here is a hand book of practical information that treats of these subjects on three main headings—electric lighting systems, electric power systems, interior wiring—and concludes with 48 tables of splendid condensed information in the appendix that are of great practical value. They are working tables that can be used to save long computations and to give definite information on the various problems involved in lighting and power applications.

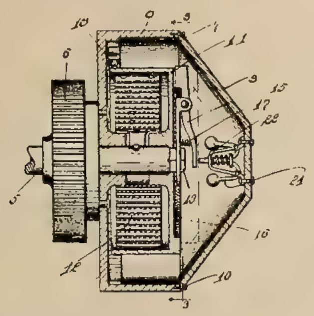
The author is head of the department of applied electricity at the Pratt Institute and was formerly electric power engineer for Westinghouse, Church, Kerr & Co. The book should receive immediate and hearty reception among the class of men for which it is designed.

WHAT WESTERN INVENTORS ARE DOING

(Deep-well pumping is proving a necessity in many arid districts of the West. Below is a brief description of an invention looking toward improvement of this nature. Other patents granted during the last two-week interval consist of a trolley-retriever, a thermometer for the cooling system of internal-combustion engines, a pressure-regulator and a plate-holder for X-ray exposures.—The Editor.)

1,219,713. **Trolley-Retriever.** Austin D. Eberly, Spokane, Wash.

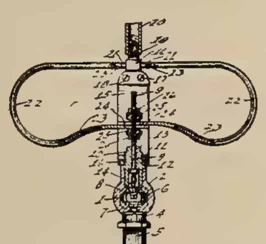
A trolley retriever, a shaft, a casing rotatably mounted thereon, an additional casing within the aforesaid casing also rotatably mounted on the shaft, a coil spring inclosed within the last mentioned casing and secured to the latter at its one end and secured to the shaft at its opposite end, spring



held means for normally holding the second mentioned casing under tension and against rotation, means for rotating the first mentioned casing at certain times, governor means operating therein for permitting the second mentioned casing to be rotated at certain times, and centrifugally operated means connecting the casings to rotate the same simultaneously upon the rotation of the second mentioned casing.

1,219,974. **Pressure-Regulator.** Charles R. McDonald, Long Beach. Cal.

A device of the character described, the combination of a pressure supply valve connected with the supply and service lines and having an extended valve stem, supporting means



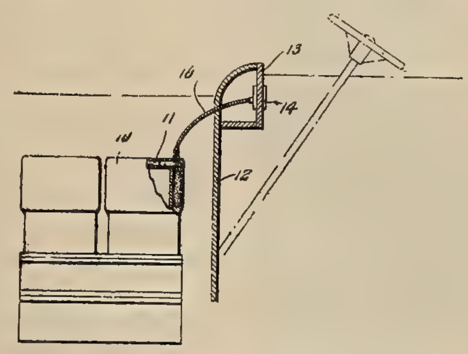
carried by the valve having an expansible and contractible pressure regulating tube held thereon, the tube being open and rigidly connected with the service line at one end, closed at the other end and adjustably and loosely connected with the valve stem, for permitting the movement of the tube relative to the valve stem when the tube is expanded and contracted.

1,219,965. **Plate-Holder for X-Ray Exposures.** Henry G. Leisenring, San Diego, Cal.

A device for taking X-ray photographs, comprising a metallic casing having a single open side, a covering of material, impervious to X-rays, upon the casing, the casing having registered openings in the opposite walls thereof, a plate of X-ray penetrable material placed over one of the wall openings, a plate holder adapted to retain a sensitized plate therein, a handle adapted to be placed around the plate holder and projecting from it, the plate holder being adapted to be moved laterally and longitudinally within the casing to bring a plate carried thereby between the openings.

1,220,150. **Thermometer for the Cooling Systems of Internal-Combustion Engines.** Oliver J. Williams, San Francisco,Cal. assignor to Philo M. Gelatt, La Crosse, Wis.

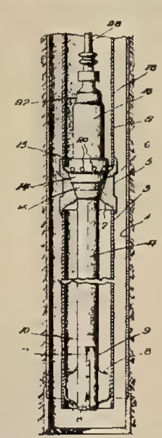
The combination with a motor vehicle and its internal combustion engine, the cylinder of which is provided with a jacket wall inclosing a chamber adapted to receive a cooling liquid, of a thermometer having its temperature re-



sponsive element secured in the jacket wall of the cylinder and projecting into the chamber where it is submerged in the cooling liquid therein, a temperature indicator located on the dash of the motor vehicle, and a flexible tube connecting the thermometer and the temperature indicating element, which tube is filled with a temperature responsive element.

1,219,799. **Deep-Well Pump.** Walter G. Black and August L. Segelhorst, Brea, Cal.

A deep-well pump, the combination with tubing, and a sleeve fitted in the tubing and having an internal conical bore forming a seat, of a pump barrel adapted to pass through the seat, a tapered anchor block secured on the pump barrel



and adapted to engage the seat, an anvil connected with and disposed above the anchor block, a plunger mounted within the pump barrel, a plunger rod secured to and rising from the plunger and passing through the anvil, means on the rod above the anvil to impinge upon the anvil and drive the anchor block to its seat, and means on the rod below the anvil to impinge upon the anvil and lift the anchor block from its seat.

LATEST IN EVERYTHING ELECTRICAL

(Engineers of the West approach the present international war crisis in America with unusual confidence in the value of service they feel they can render to the government at this solemn period of national life. Intense interest has been shown in the series of lectures that are being given in San Francisco looking toward military training for engineers. Here is a detailed account of the first three lectures of the series written by a captain of the corps of engineers and president of the examining board for the Engineer Officers' Reserve Corps.—The Editor.)

MILITARY TRAINING FOR ENGINEERS

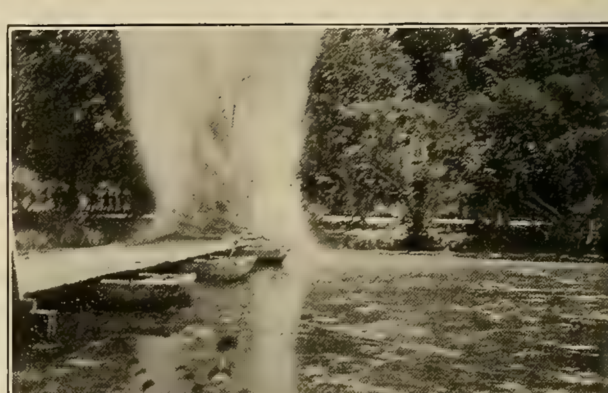
BY R. PARK

A Mine Electrically Exploded

ON March 13th Major General J. Franklin Bell, commanding the Western Department, delivered the first of an extensive lecture course being given in San Francisco, Cal., prepared with the dual object of arousing interest in the Officers' Reserve Corps and Enlisted Reserve Corps, and also of rendering assistance to applicants in their preparation for the examination. The lecture course consists of 17 lectures, properly grouped so that every subject prescribed in W. D., G. O. 32, 1916, is covered. The course was arranged under the auspices of the military affairs committee of the San Francisco Section of the five national engineering societies working in close co-operation with the department engineer, Western department, and arranged primarily in the interests of the five technical arms of the service. General Bell issued Bulletin No. 8, Western department, 1917, setting forth the general character of the work of the corps of engineers, the quatermaster corps, the signal corps, the ordnance department and in February there were mailed from the Western department headquarters 3000 copies of this bulletin to engineers all over California together with a bulletin of the National societies showing the schedule of lectures. In response to these circulars, nearly 800 men of all professions attended General Bell's lecture, "The United States Army, its officers and enlisted reserve corps." The audience was most interested and during an hour and a half talk General Bell covered the general phrases of army life, and described the essential features of the Officers Reserve Corps and the Enlisted Reserve Corps, closing with a stirring appeal for all those in the audience to apply for some section of the Reserve Corps. General Bell is an interesting and convincing lecturer, and he has the rare ability to keep his audience absolutely in harmony with his talk, whatever be his subject. His lecture has already given the Reserve Corps a great impetus on the West coast.

The second lecture was delivered by Captain Richard Park, Corps of Engineers, to a crowded hall on March 20th, on the subject "General Duties of the Different Branches of the Service." After the close of an hour and a half lecture, the meeting was thrown open, and those in search of information had the opportunity to ask questions which were promptly answered by Captain Park, or by General Bell who intends to be present at each lecture of the series. After another hour, the meeting adjourned, the 500 odd men, mostly engineers, in the audience, having displayed an intense interest in all that was said. Many questions were asked about the Reserve Corps, and the enlisted Reserve Corps proposition was put squarely up to the engineers of San Francisco and the bay cities. There seems little doubt but that at least 3000 trained engineer workmen of the various classes could be recruited in the bay cities alone if they were properly reached. It is General Bell's plan to issue each lecture of the series in the form of a bulletin and to arrange with army officers or interested citizens in all the larger cities of the Western department, to have a similar lecture course for those interested, the San Francisco lectures to furnish the text. Since the course started on March 13th the number of applications received at Western department headquarters from the bay cities has more than doubled. It is esti-

Barbed Wire Entanglement—Electrically Charged



Destruction by Electrical Means of a Pontoon Bridge Crossing

mated that at the very least 200 applications in the Engineer Corps alone will directly result from the series. The San Francisco branches of the national societies are squarely behind the movement. Mr. J. D. Galloway, civil engineer, is the chairman of the military affairs committee with Allan D. Jones as secretary. Their committee hires a large lecture hall in Native Sons of the Golden West building, and for this and other necessary expenses levies an assessment on each man taking the lecture course, the sum of $1.50.

The third lecture in the lecture course for assisting civilians to prepare for examinations in the Officers' Reserve Corps, United States Army, now being held in San Francisco, Cal., under the direct supervision of Major General J. Franklin Bell, commanding general, Western department, was delivered on Tuesday, March 27th, by Captain George M. Marshall, aide to General Bell, on the subject of "Field Service Regulations"

Captain Marshall took up the various features of the Field Service Regulations and in a very interesting and instructive way presented the subject matter to the civilians to the number of over five hundred who crowded the lecture hall in the Native Sons of the Golden West building to overflowing.

The interest already aroused by this lecture course is resulting in a great increase in the number of applications received at these headquarters and forwarded to the various department chiefs in Washington. The Western department headquarters officers have their hands full in taking care of the thousands of applicants for information, not only in connection with the Officers' Reserve Corps, but in connection with the enlisted sections of that corps. Considerable progress has already been made in getting qualified civilians to enlist in the enlisted section of all branches, especially since the commissions have commenced to arrive for officers of the reserve corps who are enthusiastically working in the interest of their organization.

The fourth lecture of the series now being given in San Francisco to prepare civilians for commissions as officers of the Reserve Corps, U. S. Army, under supervision of Major General J. Franklin Bell, was delivered on Tuesday, April 3d, by Captain J. B. Murphy, A. D. C. to General Bell, on the subject, "Military Law."

About six hundred prospective candidates for the Reserve Corps in the various branches listened to the lecture, which was presented in a concise and instructive way. With a view of giving enough data so that the essential features covered in examinations would be made clear to all who heard the lecture, each of the lectures given in this course are to be issued in the form of Western Department Bulletins, but without any connection with the training of reserve officers, and copies will be gladly furnished by Western Department Headquarters on request for same.

The next lecture will be delivered by Capt. George M. Marshall, A. D. C. to General Bell, on the subject "Infantry Drill Regulations of the United States Army."

WIRE YOUR HOME TIME CONTEST

Ever since the announcement regarding the "Wire Your Home Time" Prize Contest has been in the hands of the Central Station solicitors and the salesmen of the contractors the Society for Electrical Development has been rushed sending out contest blanks. The requests have come from the North, East, South and West in about equal numbers showing that the interest in this campaign is national.

The conditions of this contest are simple, permitting the salesmen of every member to try for a share of the $1250. The "Wire Your Home Time" committee has districted the country so that salesmen in the small cities have an equal chance with those in the metropolitan districts. There are five divisions with prizes of $250 for each division as follows:

Cities of less than 15,000 inhabitants.
Cities from 15,000 to 50,000.
Cities from 50,000 to 100,000.
Cities 100,000 to 500,000 and
Cities over 500,000.

The first prize in each division for the largest number of contracts will be $150; the prize for the second largest number of contracts will be $50 and the remaining five prizes for the next largest number of contracts will be $10 each.

Entries will be received at any time up to May 15, the closing date of the contest. Bulletins will be issued from time to time to show how the contest is coming on and what others are doing. Reports must be sent in on blanks furnished by the committee and postmarked not later than May 16.

Contestants are required to certify to the correctness of their reports by appearing before a notary and making affidavit to their number at the end of the campaign, or by certification by the local central station, general manager or new business manager.

The large number of contestants already entered insures a lively race, full of interest and one that will require staying power and "pep." Any contestant eligible should put in his application now.

ELECTRICITY FOR RURAL USE OBJECT OF CORRESPONDENCE COURSE

Electricity will soon be as universally used on the American farm as water or fire. To aid California farmers to live in the electrical age, the University of California Extension Division has announced a new correspondence course in "electricity for rural use."

NOTICE TO PUMP MANUFACTURERS, CONTRACTORS AND ELECTRIC MANUFACTURERS

A most important call for bids of pumping and electrical machinery by George Nelson, engineer for the Central Jacinto Irrigation Project, Willows, California, has arrived just as the forms for this issue are going to press. All interested must make sealed proposals by April 25, 1917, to the above engineer, from whom further information may be obtained, at the address given.

TRADE NOTE

The Catalog Numbering System of 338 Pine street, San Francisco, is the name of a new company just organized to perfect a universal filing system for catalogs. Peter Jurs in charge of catalog files at the Union Iron Works, is sponsor for the new development. The system is dependent upon a definite number being assigned to the manufacturer, which will bring about the filing of the catalogs according to size.

NEW BULLETIN

"Federal Load Building Service for Central Stations" is a question-and-answer pamphlet just issued by the Federal Sign System (Electric) that is proving to be a helpful and profitable aid for building up this form of central station load.

NEW ELECTRICAL DEVELOPMENTS

(The most striking new electrical development of the past two weeks interval is in the formation of many new highway lighting districts throughout various sections of the West. In California, where recent enabling enactments have been passed to assist unincorporated towns and villages to form highway lighting districts, this recent advance in improved highway illumination facilities is especially marked.—The Editor.)

FINANCIAL

BOISE, IDAHO.—A mortgage covering all power plants, substations, franchises and other properties has been filed for record by the Idaho Power Company, in 19 counties, in which it is operating in Idaho and Oregon. It is planned that $4,500,000 be issued on properties that were formerly subjected to nearly $19,000,000.

ILLUMINATION

FALLBROOK, CAL.—The board of supervisors are receiving bids for installing an electric lighting system and furnishing electric current for 8-250 c.p. series tungsten lights in the Fallbrook Public Highway Lighting District.

BENICIA, CAL.—Seventy-five thousand dollars will be spent by the Pacific Gas & Electric Company, installing a gas service in Benicia, if 400 signers can be secured. J. A. Royster is representing the company. A pipe line will be run from Vallejo.

RIVERSIDE, CAL.—The common council has passed an order for the improvement of Main street between Tenth and Fourteenth streets by the installation on each side of the street of electric poles, conduits and lamps for purposes of lighting.

MONTEBELLO, CAL.—An application has been made to the board of trustees of Monterey Park for the sale to the highest bidder of a franchise to construct and maintain for a period of 40 years a system of gas pipes and pipe lines for the city of Monterey Park.

MESA, ARIZ.—The council has come to an agreement with Manager Chandler of the South Side Gas & Electric Company for the purchase of the company's plant on a basis of $113,000. As soon as the proper steps can be taken the proposition will be put up to the voters of the town.

NEW VERMONT SQUARE, CAL.—A large percentage of the residents in New Vermont Square district are signed up for the lighting of their homes. The city is installing a municipal street lighting system through the square, which when completed will have an arc light at every street intersection.

TEKOA, WASH.—The city council will begin the investigation of the feasibility of a municipal electric lighting plant as the result of a petition presented by a large body of citizens. A committee consisting of Councilmen K. W. Tyler, E. R. Jones and M. Bartholomew was appointed to have charge of the investigation.

HOQUIAM, WASH.—A second special election on the proposal to bond the city for funds to condemn the electric light and power distributing plant of Hoquiam or to construct a new plant, may be called at the same time as the proposed special election to bond the city for $170,000 to take up all outstanding current expense warrants.

NOGALES, ARIZ.—This city will install 100 cluster lamps on Frank avenue and Morley avenue, Arroyo boulevard and Park and Court streets, and 150 bracket lamps on other streets, all 200 ft. apart. The lamps in the clusters are to be 100 watt incandescent burners and four 60 watt burners of the same kind. Bracket lamps are to carry one lamp each of 100 watts. The posts are to be of ornamental iron.

TRANSMISSION

YUMA, ARIZ.—The board of supervisors has granted an electric power and light franchise to the Yuma Light, Gas & Power Company, which enables it to extend its lines over the county outside of Yuma.

SEATTLE, WASH.—Bids are being received by the board of public works for furnishing all labor and material involved in the construction and installation of an additional unit to the city's steam electric plant.

SAN BERNARDINO, CAL.—Damon Cooley of this city and V. K. McMains of Los Angeles have filed application asking authority to build a power plant and system in the Big Bear Valley to furnish electricity to hotels at Pine Knot and Knight's Camp.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has taken over the Escondido Utilities Company holdings and has placed Lester A. Wright in charge at Escondido as manager. An extension of the power line from Oceanside will be made to carry current to Escondido.

TELEPHONE AND TELEGRAPH

BISHOP, CAL.—A petition of Frank Pellissier and R. S. Moore for a franchise for a telephone and telegraph line from Bishop north was rejected by the board of supervisors.

TUCSON, ARIZ.—The usual spring repairing of telephone lines from Tucson to forest stations in Rincon and Santa Catalina mountains has been ordered by Superintendent Johnson of Coroncado-Chiricahua forest headquarters here.

GARDNERVILLE, NEV.—The Bell Telephone Company has applied to the Churchill County Commissioners for the privilege to extend their toll line from Wadsworth to Fallon. They offer to rebuild the present line. It will probably cost $10,000 to rebuild the line.

TRANSPORTATION

SAN FRANCISCO, CAL.—Bids are being received by the board of public works for furnishing and delivering underground material on contract No. 83, Municipal Railway System.

LOS ANGELES, CAL.—The board of supervisors has granted the Pacific Electric Railway Company a franchise to construct and maintain an electric railroad along certain public roads and highways in Los Angeles County.

IRRIGATION

EL CENTRO, CAL.—A plan involving the expenditure of $10,000,000 and the construction of an aqueduct ten miles long, reaching from the heart of the San Bernardino Mountains to the Mexican boundary line in Imperial Valley for the purpose of delivering domestic water sufficient for 100,000 people; to irrigate 60,000 acres of land and provide 78,000 hydroelectric horsepower was announced by Colonel W. H. Holabird.

SAN FRANCISCO, CAL.—Edward N. Pearson Jr., has issued a special communication concerning $150,000 Anderson-Cottonwood Irrigation District, first issue, 6 per cent serial gold bonds. The Anderson-Cottonwood Irrigation District has a population of about 3000. It is comprised of 31,840 acres lying between Redding and Cottonwood. The estimated present market value of the land alone, excluding all improvements, is $2,650,000.

In This Issue *"A Constructive Public Policy for Utility Growth" with Departmental Discussions of Vital Interest to the Engineers throughout the West*

JOURNAL OF ELECTRICITY

VOL. XXXVIII No. 9 SAN FRANCISCO, MAY 1, 1917 PER COPY, 25 CENTS

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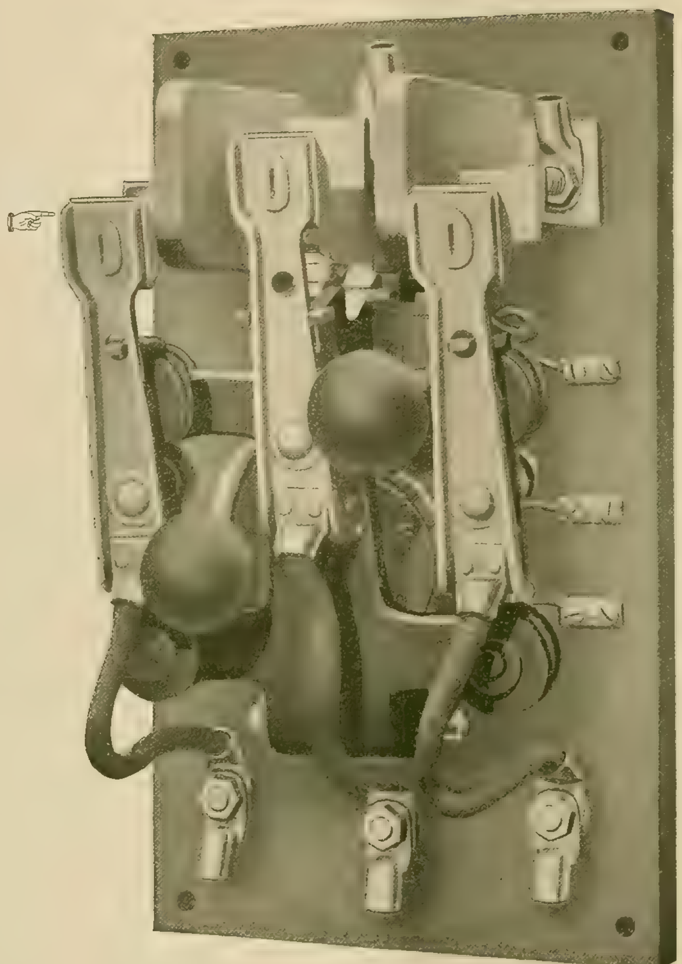

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JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII SAN FRANCISCO, MAY 1, 1917 NUMBER 9

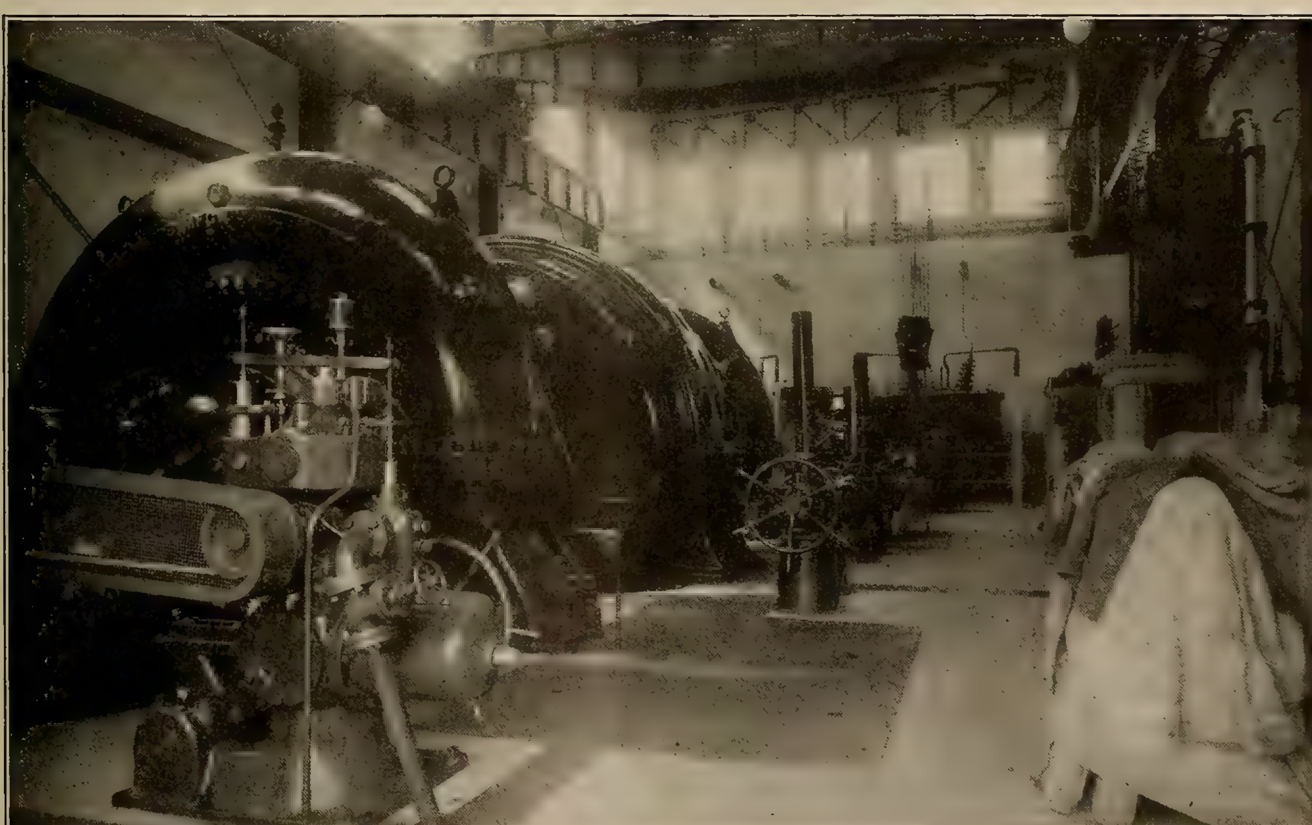
UNUSUAL DETAILS IN POWER HOUSE INSTALLATION

BY J. P. JOLLYMAN

(Details of design, construction and operation of intense interest to engineers of the West have been encountered to an unusual degree in the installation of the Halsey and Wise Power Houses recently put into service upon the transmission lines of the Pacific Gas & Electric Company. As certain physical features of these plants represent new records in hydroelectric accomplishment, the following discussion by the author, who was the engineer in charge of electric construction for this task, should command the attention of hydroelectric engineers the country over.—The Editor.)

Design

Some of the most interesting features of design of the Halsey and Wise power houses of the Pacific Gas & Electric Company are due to the fact that each contains but a single generating unit. In plants of this type it is possible to arrange the apparatus in such a manner that the cubic feet of building required for each kilowatt of capacity will be a minimum. As is seen by an examination of the interior view of Halsey power house, shown herewith, the generating unit is set with its shaft parallel with the long axis of the building and the transformers are set in a pit across the building but under the crane. The 125,000 volt switch room is immediately behind the transformers. The crane does not travel over this room.



Interior View of Halsey Power House, showing Installation of Twin Wheels on One Shaft With Single Generator Unit Between Them

With this arrangement, the crane was set 6 ft. lower than would have been possible with the transformers standing on the main floor, and the proportions of the building from an architectural point of view were much improved.

From an operating standpoint the most important feature of design is the fact that there is only one floor. This is made possible by the use of the horizontal shaft type of Francis turbine and a horizontal

generator. With all apparatus on one floor, the operation of the plant is very simple and can be accomplished with a minimum number of attendants.

The interior arrangement of Wise power house is the same as that of Halsey with minor modifications due to the use of one single discharge turbine in place of the two single discharge turbines.

The clearances between the runner and the stationary parts of a Francis turbine for high heads must be very small to secure high efficiency. These clearances at Halsey and Wise were in some cases as little as .006 inch.

The generators were not provided with bed plates for the common support of armatures and bearings. To provide for the support of the two armature sole plates, the two generator bearing sole plates, and the turbine, in such a manner that neither the .87 inch air gap of the generator nor the much smaller clearances in the turbine would be disturbed by any stresses due to operation nor by any settling of the foundations was an important problem. Even though the foundation at each plant was excavated in bed rock it was decided to lay down a concrete pad 3 ft. 8 in. thick and well reinforced, top and bottom, under the complete unit. On this pad were built up piers and walls to carry the sole plates for the armature bearings and turbine. This entire structure was built at one time up to the sole plates and allowed to set before any machinery was placed on it.

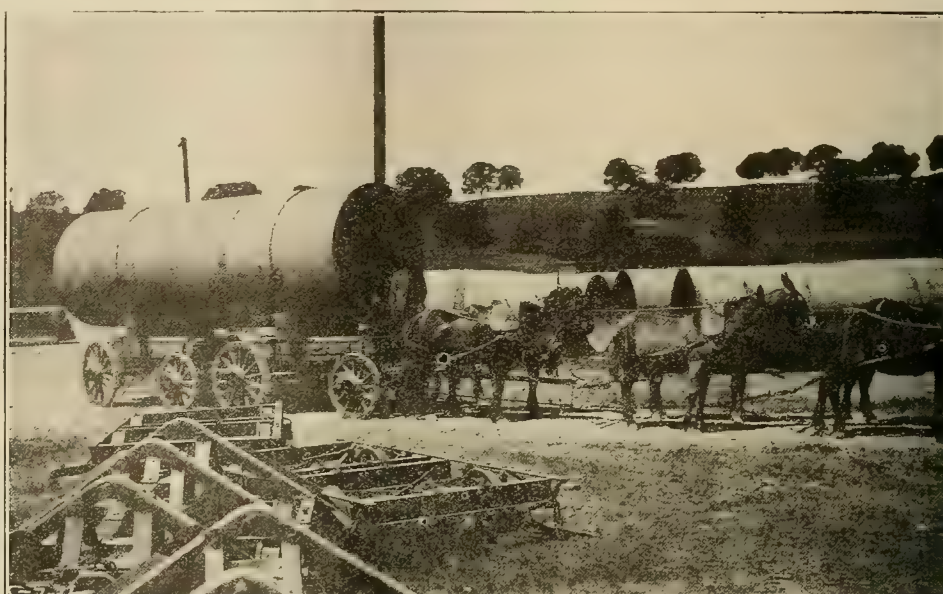
Methods of Construction

In the construction of such plants as these a number of interesting problems arise and a brief account of the solution of some of them may be of interest.

Halsey is about two miles from the nearest railroad station and Wise a little over one mile. All of the equipment had to be hauled together with the riveted steel parts of the penstock lines. For hauling the 24 ft. sections of the penstocks, some of which weighed 7 tons, use was made of two 4-wheel wagons with the load bridging from one wagon to the other, as shown in the illustration. This scheme proved very successful as the load per wheel was not excessive and the wagons rolled easily on the dirt roads. The parts of the machinery were hauled in the same manner, a platform bridging the two wagons being used where necessary.

The cores of the 4250 k.v.a. 6600 to 125,000 volt transformers were shipped standing upright while the tanks were too tall to be shipped standing. To haul the transformer cores standing vertically and loaded on top of a double wagon would make too high a load for safety nor could the cores be turned on their sides with safety to the windings. To overcome these difficulties two trusses about 22 ft. long were constructed with their ends resting on bolsters on either wagon and with the transformer core suspended between the trusses as shown. The transformer core was placed on two transverse skids which were suspended just clear of the road and were arranged to come down on the road in case of accident to either wagon. That the rig would work as planned was proven on one trip when the wheels of the rear wagon sank into a fill on a turn and the transformer settled down on the ground without damage.

The rotors of the 12,500 kw., 6600-volt, 3-phase, 60-cycle, 360 r.p.m Westinghouse generators are built up with 20 2-in. steel plates each bored for a fit on the shaft and dovetailed for the 20 poles. Now the bore of a disc subject to centrifugal force tends to enlarge, hence a rotor constructed of discs must have a very tight fit on its shaft or the rotor may become loose on the shaft when running at high speeds. The shafts were 26 in. diameter at the hub and the rotors were designed to be bored .008 in. small. This is an extremely heavy press fit, so heavy in fact that it is doubtful if the rotors could be pressed on without damaging the surfaces in contact even though the fit is in four steps. One of the rotors was heated with gas flames and shrunk on its shaft in the factory for the purpose of making efficiency and overspeed tests. When shipment was made the shaft was removed. Upon arrival, the bore of the rotor was found to be about .017 in. smaller than the shaft and the bores of two of the plates were out of round nearly .030 in. These discrepancies were undoubtedly due to pressing the rotor off its shaft in the factory. The Westinghouse Company who supplied the generator, decided to true up the bore before putting the rotor on the shaft. The rotor was placed on its side with the bore vertical and a boring bar carrying a motor driven grinding wheel was mounted through the bore.



Method of Transporting Penstock Piping

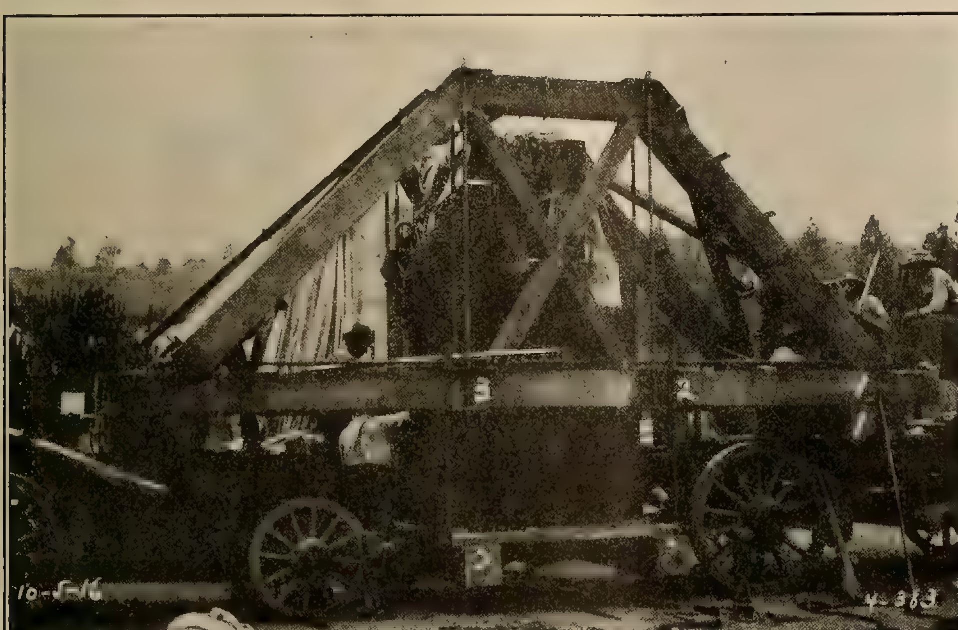
The bore was then ground out to .012 in. smaller than the shaft. The boring bar was removed, a box built around the hub and steam coils were fitted inside the box. The rotor was then heated to 135° C. which took about 36 hours and which caused the bore to expand about .033 in. The shaft was suspended from one end on the crane and lowered into the rotor. Compared with trying to press the rotor onto the shaft this plan is very much simpler and leaves the surfaces in contact in much better condition. The bore of the other rotor, which had never been assembled was found in good condition and no re-boring was done even though the bore was nearly .015 in. smaller than the shaft. This rotor was heated in a tank of water brought slowly to a boil and held there until the rotor measured nearly 100° C. As this work was done in summer the shaft was about 27° C. and it was thought the difference in temperature would hardly be sufficient, so the shaft was cooled to nearly 0° C. with a freezing mixture of salt and ice. In this case the rotor was lowered over the shaft. In view of the greater difference in temperature obtainable, the first described method is believed preferable. Further interesting details of this detail in construction may be found in the issue of the Journal of Electricity for Sept. 30, 1916.

The two generator bearings were set in place and very carefully leveled. The lower half of the generator armature was set in its pit and the shaft carrying the hub of the rotor put in the bearings. All but two of the field poles were mounted on the rotor and the upper half of the armature put in place. Using the space of the two field poles which had thus been left off the armature coils at the joints of the armature were next placed and then the two last field poles put on. The turbine runners were then put on the overhanging ends of the shaft.

After all of the revolving element had been assembled the main bearings were scraped to a final fit. Since even the most rigid shaft will sag a little under load it is quite important to have all the weight on the shaft before the final scraping of the bearings.

The turbines were then assembled and set with the required clearances between the stationary parts and the revolving parts. Each turbine is provided with a small tail shaft which is bolted to the end of the generator shaft and which extends out through the draft elbow to a small thrust bearing. These thrust bearings limit the end play of the runners and prevent them from scraping the rings in the crown plates of the turbines. To check the settings of the thrust bearings the rotor was turned over with the crane while the shaft was jacked endwise alternately in each direction. The clearances were measured with thickness gauges.

The Allis-Chalmers Company provided sufficient axial clearance in the Halsey turbines to care for .060 in. longitudinal expansion of the main shaft from heating in the bearings. The Pelton Water Wheel Company did not have to provide for such expansion on their turbine at Wise as they had only one end of the shaft to consider.



Transformer Loaded for Transit Over Mountain Road

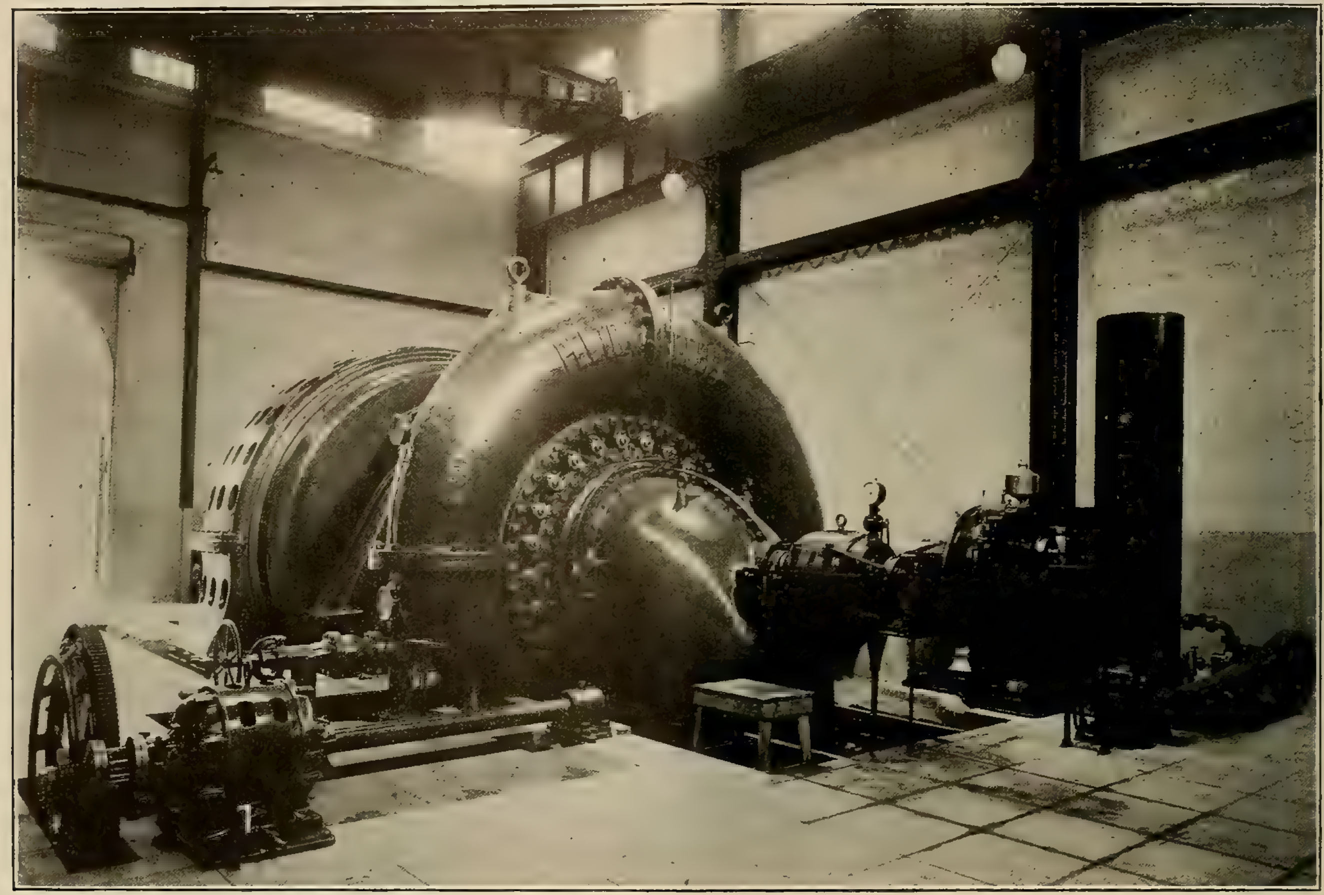
After the turbines were set and concreted into place the final sections of the penstocks and draft tubes were put into place, drilled and riveted. This method of making the final pipe connections eliminates any initial stresses in either pipe or machinery from lack of absolute alignment of the parts connected.

The 4250 k.v.a. Allis-Chalmers transformers were very carefully dried before being filled with oil and put into service. This drying was accomplished by heating the windings to about 85° C. in the tanks with steam in the water coils and by maintaining a vacuum of about 20 in. within the tanks. To maintain a more uniform temperature throughout the tanks, they were jacketed with several layers of building paper spaced apart with wood strips. The dryness of the insulation was judged from megger readings taken from each winding to ground, also between windings. As the windings heat up, the megger readings drop from about 200 megohms to about 100 megohms, then gradually rise to about 2000 megohms at which point they are considered dry. This drying requires from 5 days to 13 days per transformer, depending on its initial condition. While still hot, the transformers were filled with oil which had been dried in a filter press.

Operation

However carefully such large units may be assembled even greater care must be exercised when the unit is first started up. In fact several days are usually required from the first turn-over to prepare the unit for regular service.

First the main bearings must be worked in by many hours of running at reduced speeds. Even with the most careful scraping some high spots will remain and these must be given time to smooth down before the bearing is run at full speed or they will heat excessively and may burn. Then the generator armature windings must be dried out by 36 to 48 hours of running on short circuit with sufficient field current to give full load armature current or more. The condition of the armature insulation is judged by the megger and was, for these generators, brought up to about 10 megohms at 80° C.



Interior View of Wise Power House, showing Mammoth Single Discharge Unit

After the unit is dry and up to speed the voltage is built up very slowly and the machine carefully watched for any smell of ozone which would indicate a lack of sufficient dryness. Next the transformers are built up to voltage with the generator, then they are switched off the generator and into the system with which the plant is to run in parallel. The electrical rotation of the generator is then compared with that of the system and if found correct the unit may be paralleled with the incoming line.

Synchronizing the plant with the system for the first time is an event of much interest marking as it does the formal completion of the plant. Accounts of the ceremonies at Wise were given in the Journal of March 15, 1917.

Turbines operating at the ends of long penstocks must be equipped with relief valves or their gates cannot be closed quickly without causing water hammer in the penstocks.

The Halsey penstock is 5418 ft. long and the Wise penstock is 8546 ft. long. The stored energy in the latter is about 35,000,000 ft. pounds for a flow of 400 second feet which is full load. Obviously this energy must be absorbed slowly or a very great pressure rise would result. 8The turbines in both plants are equipped with governor operated relief valves which open as the turbines close and then close at a rate determined by a dashpot which can be set for any desired closing time. A closing time of about 1½ minutes was found sufficient for both the Halsey and Wise penstocks.

To avoid excessive rise in speed on sudden loss of load the closing time of the turbine gates should not exceed 3 to 4 seconds. The relief valves must open in this same time and in such a manner that the rate of flow of the water in the penstock will not be materially changed.

The final tests on the plants consist in pulling up loads of gradually increasing amounts and then separating from the system by opening the generator switch. As the speed starts to rise the governor starts to close the turbine gates and to open the relief valve. Some disturbance in the penstock pressure is inevitable so the pressure gauges are watched and the relief valves readjusted before another test is made if the results are not satisfactory. Loads as high as 9200 kw. were dropped instantly on these tests with a pressure rise of only 11 per cent above the static pressure.

One of the most interesting things that happened during the starting of the plants was the permanent lengthening of the generator shaft by about .035 in. This occurred during the first hour of operating and is believed to be due to the shaft relieving itself under the influence of the alternate bending stresses of some of the great compressive stress set up in the shaft by shrinking on the generator rotor

CONSTRUCTIVE PUBLIC POLICY FOR UTILTY GROWTH

BY JOHN A. BRITTON, Chairman

(Constructive public policy on the part of utility managers throughout the West proved to be the keynote of thought and discussion at the recent gathering of electrical men at Riverside. It is almost with profound reverence that the following beautiful and masterly composition is set before our readers. Composed of a public policy committee consisting of John A. Britton, chairman, Pacific Gas & Electric Company, San Francisco; W. A. Brackenridge, Southern California Edison Company, Los Angeles; H. H. Jones, San Diego Consolidated Gas & Electric Company, San Diego; S. M. Kennedy, Southern California Edison Company, Los Angeles; A. G. Wishon, San Joaquin Light & Power Company, Fresno, this remarkable document was delivered at the first annual convention of the Pacific Coast Section of N. E. L. A., April 19-21, 1917. Coming as it did at a time of unprecedented world stress, as the venerable chairman proceeded in reading the concluding remarks in his report, each listener involuntarily raised himself higher in stature and pledged again loyalty to his God, his country and himself.—The Editor.)

Your public policy committee approaches, with very considerable pleasure, its initial recommendations to the geographic section; for the section has, by reason of its peculiar geographical situation, and because of necessity of its initiative, had to confront more intricate problems and settle them in its own way than has any other section of the United States. This not only relates to its operative conditions, but its political as well.

Of most importance to the companies constituting the geographic section, it seems to your committee that inter-company relations stand out significantly. In most of the other states a consolidation of interests is provocative of a unity of relation and a mutual defense against attacks, however made, and a unity of interest in protection also of rights, and in an avoidance of precedents being established before the courts, the railroad commissions, and legislatures.

It is recommended to this section that through the executive officers a plan be outlined by which no member of the association will take up initiatively any matters before court, commissions or legislatures, wherbey a precedent would be established, without the consent of either the executive committee or of the public policy committee.

Much closer inter-company relations would be of material assistance to any member company, when presenting a case before a court or railroad commission; and would enable the member company to eliminate testimony which might be contradictory, and to bring out all the essential points, so that the company's contention might be placed before the court or commission in the most forceful manner possible.

Next in importance is the attitude of public utility companies as concerns their relations with the railroad commissions. Prior to the institution of regulation by commissions, conditions were such as might be expected from a freedom of operation; and because these conditions have been removed the public utility companies are grateful, and look to a protection from regulation, that eventually is bound to prove beneficial. Regulation has by elimination of public utility companies from the domain of politics accomplished a needed reform.

Rate fixing, as determined by companies on their own initiative, consisted of a hodge-podge of uncertainties, and the novices in the game had a better chance of being heard than experts. Rate making is a science of which but little is known, and of which we have much to learn; and by and with the advice of the railroad commission we are gradually being educated to a method of rates for service which stand for stability and uniformity and the protection of investments.

There can be no question that public utility securities under regulation have become more stable, taking on much of the standing that city, county, state and national securities possess.

It is certainly to be hoped that some day the general public, now falsely educated by the press generally in the matter of municipal ownership, will consent that the powers of the commission of this and other states include municipally controlled utilities to the fullest extent. Less fear would be entertained of municipalities engaging in the public utility business if the truth in regard to those already established were fully known. This will never be known so long as their methods of operation are controlled by a few office-holders. This section should work toward the end of educating, in every way, the public to the realization that privately-owned utilities should be treated fairly, and its action should not be handicapped by a competitor who can do the very things which are forbidden under regulation to the public utilities privately owned.

We recommend that all public utilities be honest, fair, frank and open in all of their dealings with the commissions of the several states, so that absolute confidence will prevail in the minds, not only of the commission itself, but of its subordinates. Strict compliance, therefore, with all requests of commissions is enjoined in a frank exposition of any position in which a utility may find itself by reason of commission needs.

It may truly be said, in support of the often-enunciated principle by state commissions, that regulated monopoly is more effective than competition in giving better service to the public. Your committee, however, is of the opinion that public service will never be given as satisfactorily when controlled municipally as it will be when operated and given by a privately owned corporation, because of the greater stability of the organization of the privately owned utility.

There is a constantly recurring feeling among companies and their employes now under regulation that the old-time incentive to economical administration, and consequent betterment to both employer and employe, does not now exist; that improvements to either apparatus or conditions of operation are taken away in their effectiveness by the general determination of the commissions to allot only a certain return

on capital. It would seem desirable that commissions should as soon as possible announce a policy in this regard.

Taxation has become something of a problem in this and other states, and while in California the departure from the ad valorem method of taxation was deemed to be a proper solution, the constantly increasing percentage of the gross revenue brings up the question as to whether or not it has solved the problem of taxation. The finding of the State Tax Commission that the assessed value of corporations, estimated either on the ad valorem basis or on the bond and stock basis, was not on a par with the assessed value of other properties of the state, reveals a weakness in the methods of determination of value. It was recommended by the Tax Commission of the State of California that the rate be raised from 5.25 per cent to 5.60 per cent of our gross. As the exigencies of the state continue, we feel that there should be a limitation to the percentage amount that may be required of the gross. It is a correct assumption that this burden must fall upon the rate payer, for it is included in the operating expense of corporations; and therefore it must be absorbed in increased rates for service, and must be considered by the railroad commission in fixing rates. Unlike the ordinary seller of products, however, a public utility cannot from day to day or month to month increase its rates as its burdens increase; but must maintain the rate fixed, no matter how heavy the burdens are, until commissions in their wisdom, on extended hearings, determine that the rate is burdensome.

In order that there may be a parity between municipally owned and privately owned utilities, your committee is firmly of the opinion that the state should tax municipally owned utilities in the same manner and at the same rate as similar utilities operated by privately owned companies. Common fairness of treatment, and the state's necessities, would seem to dictate this policy. Tax exemption of publicly owned utilities, results in an uneven and unjust distribution of taxes. Municipalities were not the pioneers in any public utility undertaking, but played the waiting game and came in to reap the benefits of the brains and capital of others who have made developments, and it seems manifestly unfair that they should now take advantage of them still further in exemption from the same burdens as the privately owned utilities have to endure.

It is recommended by your committee that exhaustive inquiry be made, by a committee to be appointed, into the question of taxation in all of the states involved in the section, in order that at our next meeting, which shall be prior to the next convening of legislatures, a thorough understanding of this question may be had, and that the companies interested may be prepared to resist any further increase of that particular burden of operation.

Your committee strongly recommends that greater efforts be made through the section for the education of the masses in the knowledge of our industry, either through the agencies of the universities and schools or by public meetings. Familiarity with our institution will provoke favorable notice. The acts of all public utilities should be open and above board and the public should be familiar with its aims and ambitions as well as with its trials and tribulations, and a constant campaign along this line will do more to enlist the good will of the public and secure finally that which we alone desire—the recognition of a just return upon the capital in our hands as trustees devoted to public use.

It is a well-known fact that 95 per cent of the complaints against public utilities originate from an unthoughtful or discourteous act of some subordinate, which would not be tolerated by the managers of the companies, had they knowledge. Each company should endeavor, through a proper agency, to educate its employes in courtesy towards the public—and some officials will bear education in the same line. Promptness in attention to complaints and replying to communications, and the recognition at once of any claim of a customer, just or otherwise, will do more towards strengthening ourselves with the public than any other means we can employ, and the public should be educated to the fact that the companies invite, constantly, any recommendations or criticisms, in order that closer relations be established.

The care of employes should receive our very serious attention. It is desirable that where conditions will permit a general and uniform rule among corporations of our character with respect to the care of the sick, and a certainty by a pension plan of old employes being properly cared for.

Employes should be educated along the line of connecting themselves as stockholders with the companies for which they work, in-so-far as their financial ability will allow. Proper wages and compensation should be paid to employes; and this, if done in a voluntary way, would result in less trouble from labor union agitators.

The recent formation of the highway commission of this state has presented some very serious problems that time alone can work out.

Your committee is of the opinion that it would be advisable for representatives of member companies to discuss with the highways commission some of the conditions to which the commission has at present taken exception. It is probable that an agreement between the companies and the commission for uniform construction, painting of poles and joint occupation of pole lines where possible, would do much to smooth out the wrinkles and eliminate most of the objections which the commission has recently made.

The Pacific Coast states have a tremendous future and prospect, and the expanding industries will require from corporations in our class a large capital expenditure. The railroad commissions, mindful of this fact, have been and will be lenient in permits given for enlargements of capital, as they by that means will be a great factor in the upbuilding of the state; but we must do our share in finding money at the lowest possible price. This can be done by maintenance at all times of economic conditions in our business and by proper spending of the capital obtained produce a diversity in our distribution that will continually help to minimize costs and therefore permit the lowest possible rates to be given for service.

There is one point upon which the commissions must be educated, and that is the question of discrim-

ination. In the development of the business in this state electrically it is important not to consider discrimination in a limited sense, in order that we may obtain the very best results for the company and for the public in general. There are classifications of service that need regular schedules of rates; there are others, such as infant industries, that need protection; also mining developments, uncertain in their initial stages (by mining we also include oil), where fixed schedule of rates applicable to going concerns would be detrimental to the growth of the newer industries, and a certain amount of reasonable discrimination should be allowed. We recognize that there may be wise and just discrimination between different classes of consumers, but that there should be no discrimination between consumers of any particular class.

Regulation in the sense heretofore used will certainly be of no benefit unless it is accompanied with a monopoly. Companies occupying certain territory should not be put under the burden of competition, but should be compelled, at rates under regulation, to serve all of the territory, and it should not be able to excuse itself nor give such service as will compel commissions to permit competition. So long as there is no monopoly under regulation, just so long will it be impossible for companies to reasonably finance themselves for the extension of new business that may be forthcoming. It certainly will have a distinct tendency to scare away the timid investor who fears both competition and regulation.

Where competition does exist and where lines parallel those of the telephone company, due consideration should be given to joint pole agreements. The sparsely settled sections of each state require, in order to develop any particularly new business, long lines that are not remunerative. The joint pole solves this problem to some degree and has proven in certain cases very satisfactory, the electric competing and telephone companies co-operating more and more. The telephone companies would do more if they could be educated out of the notion that a higher voltage on our lines than 4000 is detrimental to their service. In this connection, the inductive interference committee, appointed by the state commission and the power companies jointly with the telephone companies, are working out some of the problems; and it is our belief that a greater amount of co-operation can be later obtained from the telephone companies.

The last few years have shown a marvelous development of the uses of electricity on the farm and generally for agricultural purposes. The education of farmers to the benefits of electricity has been a constant effort on the part of member companies in our section, and the results are viewed with astonishment by eastern companies. It would be interesting to know just what part the use of energy for all purposes of agriculture, including reclamation, irrigation, and power on the farm, both for domestic and other uses, bears to its use for other purposes.

It may be assumed in the present condition by which this country is involved in war that the mind of the public may be taken away to a degree from public ownership, and with the suggestions heretofore made, and with apparent legislation in some states bringing municipally owned utilities under control of the commissions, the development of the onerous burdens placed upon the taxpayers by municipally conducted plants will be brought forcibly to the attention of the taxpayers.

Having in mind the possibilities of a call from the national fiovernment, to the citizens of this nation, for service in the ranks, your committee strongly recommended the adoption of the following resolutions, which on submission at today's session were unanimously adopted:

"Whereas, the safety and welfare of this Nation in times of war, as well as in peace, demands the continuance of transportation and industrial and agricultural pursuits; and

"Whereas, the public utilities of the classes represented here are large factors in the furnishing of energy for transportation, light, heat and power purposes, and particularly in the supply of industrial and irrigation purposes; now, therefore, be it

"Resolved, that we tender the use herewith of our system and service to the government of the United States in protecting it in necessary transportation, manufacture of munitions of war, ship-building, raising of food-stuffs, and other necessities of life.

"Resolved, further, we favor selective conscription, and that a copy of these resolutions be forwarded to the President of the United States and the Governors of Arizona, California, Nevada and New Mexico."

AN INTERESTING SHORT-CIRCUIT PHENOMENON

On patrolling the line of the Boston Edison Company as recounted in the February issue of Edison Life, the trouble man found one of the lines on the ground, with one of the squirrels shown in the cut lying dead beside the wire. The other squirrel was wedged in the crossarm brace on the pole, and was

The Kiss of Death

also dead. On examination, it was found that the bodies and noses of both animals were burned. The nature of the burns disclosed the fact that one squirrel was on the line, and the other was on the brace which is grounded. When the little animals touched noses, a flash over from line to arm was caused, which burnt off the wire and resulted fatally for the unfortunate lovers. Which goes to show that the top of a pole carrying 13,800 volts is a bad place for spooning.

PROBABILITY PAPER FOR DISCHARGE RECORDS

BY FRED F. HENSHAW

(The use of probability paper in the analysis of hydraulic data has been presented by Allen Hazen in the Transactions of the American Society of Civil Engineers, page 1539, 1914, in an article entitled "Storage to be provided in impounding reservoirs." In this excellent article the author, who is district engineer for the U. S. Geological Survey at Portland, Oregon, cites specific instances from data taken on Western streams which should prove very useful to engineers having discharge record tasks ahead of them in the study of stream flow.—The Editor.)

In plotting observations the whole space is divided into as many vertical strips as there are terms, and the figure for each term arranged in order of its magnitude is plotted at the percentage that corresponds to the middle of its strip; that is to say, if there are 50 terms in the series each is taken to represent 2 per cent of the whole space. The first term will be plotted at the middle of the first 2 per cent strip on the 1 per cent line; the second term will be plotted in the middle of the second strip, or on the 3 per cent line. If the data for any series correspond strictly with the normal law of error, the points plotted on this paper will define a straight line. If the data approximate the normal law of error the line through the points will approximate a straight line. Even though the deviation from the normal law of error be considerable a line with only a moderate curvature may represent it fairly well. Regardless of the number of observations in the series, 10 per cent of them will fall to the left of the 10 per cent line, and 20 per cent to the left of the 20 per cent line. Therefore the line may be used to determine the probable percentage of years in which a flood of given magnitude will be exceeded or for which the minimum discharge may be less than a given value.

To illustrate the application of probability paper to studies of flood discharge, maximum flood discharges have been plotted for Columbia, McKenzie, and Deschutes rivers. For Columbia River the record of maximum floods covers 58 years. Thus the year of highest flood, 1894, is plotted in the middle of the strip representing 1.73 per cent or 1/58 of the whole time; that is, on the .86 per cent line; the year second in height of flood, on the 2.59 per cent line, and so on. The straight line is drawn averaging all the points thus plotted. If the series of records covered a long enough period it is assumed that they would all plot on this line. It will be noted that the mean line passes considerably below and to the left of the point for the flood of 1894. The line reaches the discharge value for this flood at the point at which would be plotted the highest observation if a 500-year series were available. It may be accordingly concluded that in so far as this method of reasoning holds true the recurrence of a flood equal to that of 1894 may be expected only once in 500 years. For the McKenzie we have records covering 10 years, and the observations define a curve fairly well. For the Deschutes the points lie on a much flatter curve than that for the McKenzie, as might be expected of a river of its remarkably uniform regimen. The flood of 1909, however, is way off the curve, and a flood of this magnitude appears to be reasonably expected hardly once in 1000 years.

The values of total yearly run-off have been plotted in a similar manner for three streams—Sacramento River at Red Bluff, Cal., and Powder and Deschutes rivers in Oregon—and minima have been plotted for Columbia, Deschutes and North Umpqua rivers, Oregon. The degree of regularity of flow of a stream, year by year, may be measured by the percentage of variation that may be expected, say, one year in ten. It is found by expressing the value intercepted by the probability curve on the 5 per cent or 95 per cent line in terms of its variation from the value at the 50 per cent or median line.

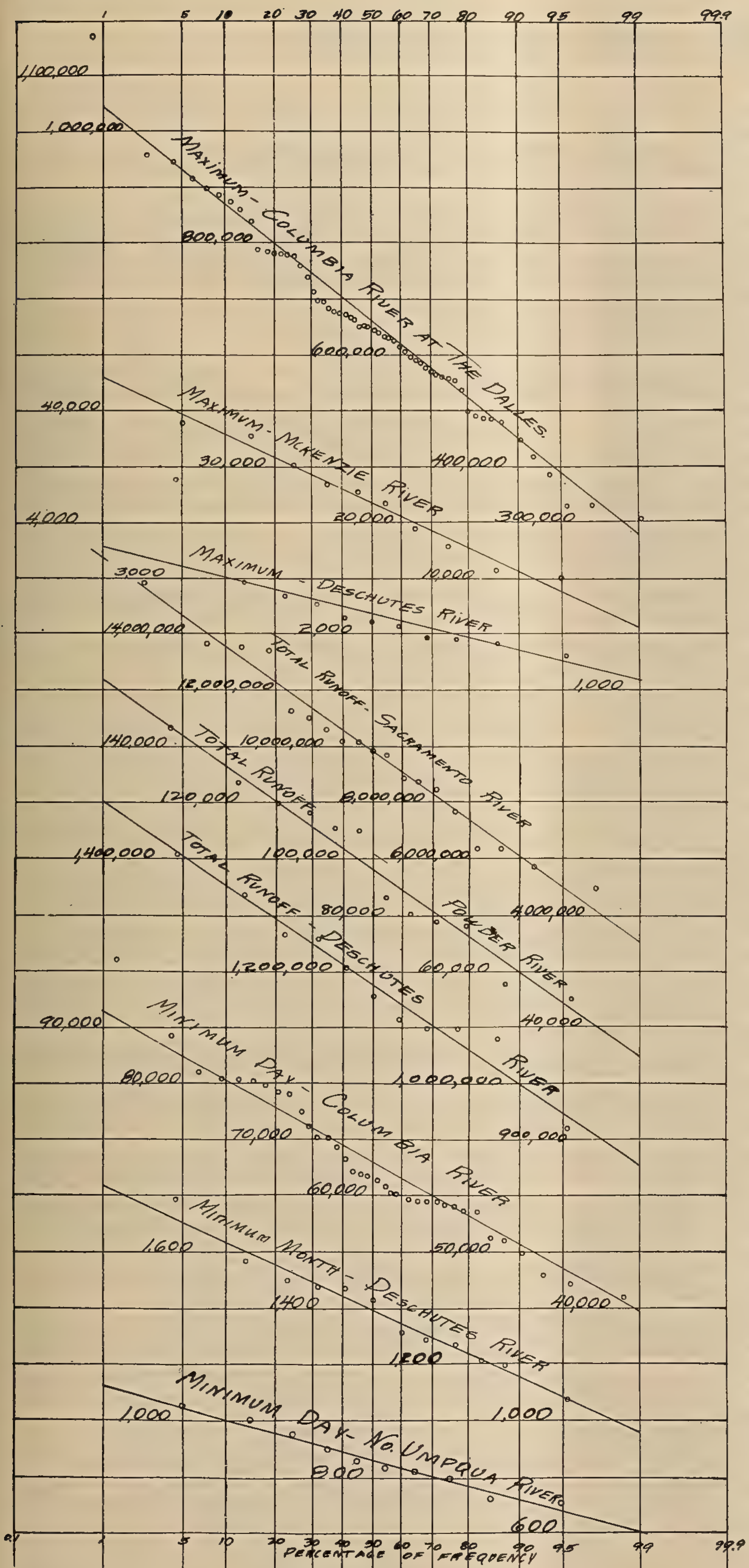
The total run-off of the Sacramento shows a variation on the 5 per cent and 95 per cent lines of $\pm$ 49 per cent, that of the Powder, $\pm$ 50 per cent, and that of the Deschutes $\pm$ 19 per cent; that is, in the case of the first two streams the total annual run-off one year in ten may be expected to be 50 per cent below, and one year in ten 50 per cent above the average. But on the Deschutes the year of highest or lowest run-off may be expected to vary from the average less than 20 per cent one year in ten.

The minimum mean for the Columbia is about 66,000 second-feet, the lowest recorded value 41,600, the value on the 95 per cent line, 47,000, and the coefficient $\pm$ 29 per cent; for the Deschutes the mean is 1400 second-feet, the year of lowest annual run-off in ten, 1090 second-feet, the coefficient $\pm$ 23 per cent; for the North Umpqua the coefficient is $\pm$ 21 per cent. The Deschutes and the North Umpqua are almost wholly spring-fed at low water, which in great measure accounts for their regularity.

The accuracy of definition of a probability curve may be tested, like that of any curve, by the deviation of the plotted points from the mean line defined by them. Thus, for the total run-off of Powder River the variation of the plotted points is from + 10 to — 11 per cent; for the Deschutes it is from + 5 to — 5 per cent. The line representing the probable future regimen is much better defined for the Deschutes than for the Powder. For minimum flow the maximum deviations for the Columbia are + 11 and — 6 per cent and for the North Umpqua, + 3 and — 4 per cent.

The deviations for any 10-year record on Columbia River would be greater than for the 38-year record used. In general, the degree of the curve of probable occurrence varies inversely with the coefficient of variation and directly with the number of years of record.

The engineer making a study of any hydraulic problem involving the utilization of the water of a stream has on the one hand the discharge records, and on the other certain facts and assumptions as to the probable use of water. With probability paper its analysis becomes much simplified.



The Use of Probability Paper for Discharge Records

CHEMICAL ACTION OF WATER ON OIL

Work in the California oil fields by the United States Geological Survey of the Department of the Interior has developed some interesting facts which will doubtless be of considerable benefit to the oil industry.

The progressive alteration of the water as oil is approached is so constant and so striking in the area examined that the conclusion that the oil and water have reacted chemically can not be avoided. It was suggested long ago in the Russian oil fields that hydrocarbons are able to reduce sulphate to sulphide, and that they themselves are simultaneously oxidized to carbon dioxide or carbonate.

Some of the sulphide formed in the reaction between the hydrocarbons and the sulphate waters is undoubtedly oxidized to sulphur. Some of this sulphur is taken up again by the oil, which makes the oil heaavier and more asphaltic. In the oil fields of San Joaquin Valley the oil that has been most exposed to the action of the water generally contains the most sulphur and is of the highest gravity. It seems probable that the natural gas is also affected by these reactions, and that some of the carbon dioxide formed is not taken up by the waters but mixes with the gas and thus lowers its heating value. The gas nearest the outcrop of the oil sands, where sulphate water can most readily enter the strata and where the reaction would most naturally be most vigorous, may contain as much as 35 per cent of carbon dioxide.

A preliminary report on California oil-field waters, containing a number of analyses and a discussion of the principles that control the chemical variations in the waters, has just been issued by the United States Geological Survey as Bulletin 653, entitled "Chemical relations of the oil-field waters in San Joaquin Valley, California," by G. Sherburne Rogers. This report also points out how the principles set forth may probably be put to practical use by oil operators. A copy of the report may be obtained on application to the Director of the U. S. Geological Survey, Washington, D. C.

MAXIMUM DEMAND METERS

BY W. A. HILLEBRAND

(The use and development of the demand meter due to peculiarities of central station load throughout the West is a subject that is receiving an immeuse impetus among central station engineers and regulating bodies alike. Here is an excellent article that deals with the treatment of the demand meter in an exhaustive manner. In its completeness it will appear in three separate issues of the Journal. The author is a well-known investigator and authority on central station use of demand meters and is with the engineering staff of the Pacific Gas & Electric Company. He delivered this paper before the recent meeting of the San Francisco Section of the American Institute of Electrical Engineers.—The Editor.)

An increasing tendency on the part of central stations and public service commissions to favor a demand and energy rate for service has, within recent years, greatly stimulated the use and development of the maximum demand meter. The importance of the demand element in such a charge is illustrated by the following hypothetical but representative rates:

Rate Number 1

Demand charge of two dollars per month per kilowatt of maximum demand. No energy charge.

In this rate the demand element is one hundred per cent of the total charge.

Table Number 2

Demand charge of two dollars per month per kilowatt of maximum demand, with a minimum bill corresponding to a demand equal to 50 per cent of the connected load in kilowatts.

In this case the consumer's actual demand has no effect upon the charge for service until it exceeds a minimum of half of the connected load. It will rarely be responsible for half of the total bill.

Table Number 3

Demand charge of one dollar per month per kilowatt of maximum demand with a minimum demand of 50 per cent of the connected load.

Energy charge of one cent per kilowatt hour.

The monthly charge for service with this rate, under representative conditions, is indicated in Table 1, in which the demand charge is only that due to the excess over fifty per cent of the connected load.

Table No. 1.

Connected Load, kw.	Demand, kw.	Load Factor, per cent.	Kilowatt Hrs.	Minimum Charge	Demand Charge	Energy Charge	Total Charge	Demand Charge, per cent of total
1.0	.5	25	180	.50	0	1.80	2.30	0
1.0	1.0	5	36	.50	.50	.36	1.36	37
1.0	1.0	15	108	.50	.50	1.08	2.08	24
1.0	1.0	25	180	.50	.50	1.80	2.80	18
1.0	1.0	50	360	.50	.50	3.60	4.60	11
1.0	1.0	80	576	.50	.50	5.76	6.76	7.5

The demand element of a rate such as number 3 will rarely affect the total bill by more than thirty-five per cent.

Rate Number 4

Where the monthly maximum demand is not over 100 kw.:

2.5 cents per kw.-hr for the first 50 kw.-hr per month per kw. of maximum demand.

1.5 cents per kw.-hr. for the next 50 kw.-hr. per month per kw. of maximum demand.

1.0 cents per kw.-hr. for the next 50 kw.-hr. per month per kw. of maximum demand.

.8 cents per kw.-hr. for all over 150 kw.-hr. per month per kw. of maximum demand.

Minimum monthly charge, one dollar per kilowatt for 20 per cent of the connected load.

This rate is designed to favor the consumer with a good

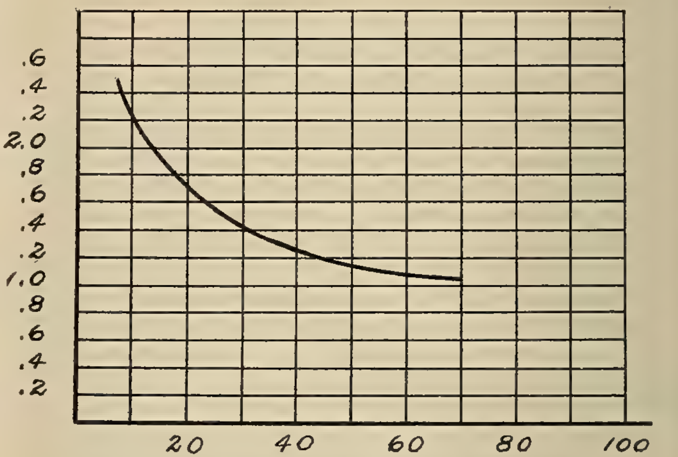


Fig. 1. Curve showing Rate Variation in Cents per kw.-hr. with Load Factor in Per Cent

load factor, and its variation with load factor is indicated in Fig. 1, which shows that a change in load factor from 10 per cent to 20 per cent, or a 50 per cent change in demand for a given kilowatt hour consumption, will affect the average rate per kilowatt hour and the total monthly bill by less than 23 per cent.

The foregoing examples have been cited in order to illustrate the fact that the importance of the demand meter and its accuracy of registration will, in any particular case, depend upon the nature of the rate applying. With so much by way of introduction, the balance of this paper will deal only with the demand meter itself, and will consist in a description of various types with comments on their respective advantages and defects.

A maximum demand meter must perform three functions, measure the maximum load in kilowatts, average that load over a definte time interval, and give a permanent and reliable record of its indication. It should be moderate in cost, accurate, dependable and require little attention. So far as the writer's experience goes, no device on the market today more than approximately fulfills these requirements.

Meters for measuring the maximum demand are of three general types:

1. Graphic indicating instruments.

2. An indicating wattmeter or ammeter, with its movement constrained by some device to give a suitable time lag. To this class belong the

Wright demand meter.
General Electric types H and W.
Westinghouse type R O.
The proposed Lincoln thermal wattmeter.

3. A device for recording the kilowatt hours delivered in a definite time interval, either graphically or by some other indication. With the exception of the Wrght demand meter, this is the most popular and

widely used type of instrument. To this class belong the

Graphometer,
Printometer.
Ingalls Relay Demand Indicator.
General Electric types M-2 and M-4.

There are other instruments of this classification which perform the same function but are not mentioned by the writer because he is not familiar with them.

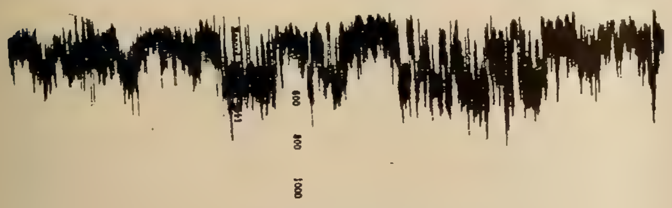


Fig. 2. Record of Fluctuations Due to an Air Compressor

In considering the duty of a maximum demand meter it must be borne in mind that, due to the overload capacity of apparatus, the demand in which the power company is interested is usually not the instantaneous maximum but the demand averaged over a suitable and specified interval, such as five, fifteen or thirty minutes. In some cases the consumer's momentary demand, more than any average, determines the cost of service, but such fact is, so far as the writer knows, commonly disregarded in establishing rates. All the meters herein referred to, except of the graphic indicating type, are designed to give the average maximum demand over a period of at least five minutes.

Graphic Indicating Instruments

A graphic indicating ammeter or wattmeter may be used to measure demand over any desired period the avantage that it gives the load curve and time of consumer's maximum. However, such an instrument is high in first cost, requires constant attention, is not very accurate and is difficult to read. On fluctuating loads the errors due to inertia of moving element are very great, and furthermore, if the fluctuations are very rapid, the ink will either not flow rapidly enough to record or will have a broad band which makes the precise determination of the quantity sought a matter of opinion. Such a record is illustrated in Fig. 2, in which the fluctuation was due to an air compressor.

With a strip chart having a speed of three inches an hour, which is about the minimum for a satisfactory record, one meter will require 180 ft. of chart per month, which must be gone over, the point of average maximum determined by inspection and the area generally integrated with a planimeter.

Some graphic instruments also constitute such a heavy load as to appreciably affect the accuracy of current transformers to which they may be connected.

On the whole, the disadvantages of such a method of determining maximum demand are so great as to eliminate this class of meter except for occasional use.

Lagged Indicating Meters

One distinct class of demand meter uses a heavily damped indicating element that, with a steady load applied, will indicate that load only after the lapse of a considerable period of time. In all meters of this class the time lag is inherent in the design and is not produced by any external device. Three of such meters are illustrated in Fig. 3, the Wright Demand, Westinghouse type R O and General Electric type W.

The characteristic behavior of meters of this class is indicated in Fig. 4, in which the load is assumed to be constant for fifteen minutes, then to double for seven and one-half minutes, at the end of which time it drops to zero. If the time interval of the meter is fifteen minutes it will give an indication that will vary with the time according to its characteristic curve AB. At the end of fifteen minutes it correctly indicates the load B. If a load equal to Y had been applied at A, the meter would have followed the dotted curve. Now, when the load at B is doubled, the meter records along the curve BC, parallel to and identical with the curve AD, so that when the load finally drops off its indication is some such value as C, whereas the fifteen minute average maximum is a smaller value, E. One recently developed type of meter, with a time interval of fifteen minutes, will record on this load the value D, or 33 1/3 per cent above the average maximum for fifteen minutes.

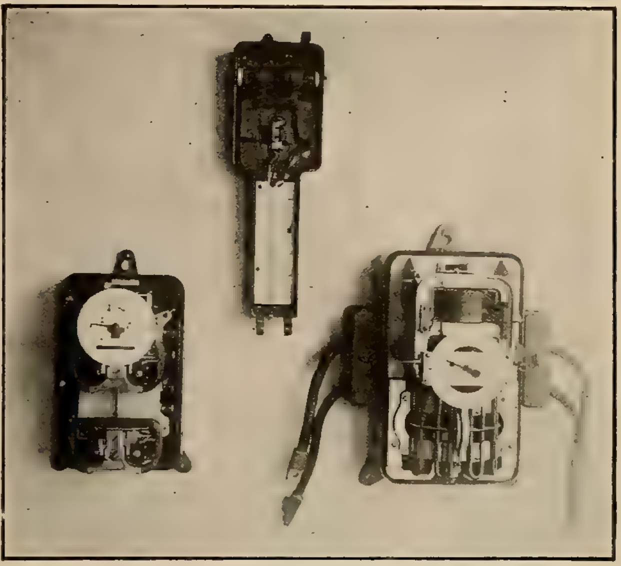


Fig. 3. Three Meters of the Time Lag Design

Wright Demand Meter

Perhaps the earliest and most widely used demand meter is that invented by Wright and which bears his name, see Fig. 5. It consists of a glass U tube partly filled with a non-freezing liquid such as sulphuric acid. B_1 B_2 are hermetically sealed bulbs containing air, the one on the left hand being enclosed by a heater strip in series with the circuit. When ready for operation the liquid stands at the level of the index tube I. Air confined in the left hand bulb is heated

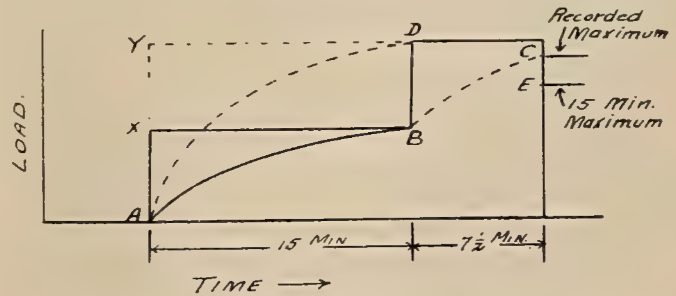


Fig. 4. Typical Performance of Indicating Type of Demand Meter

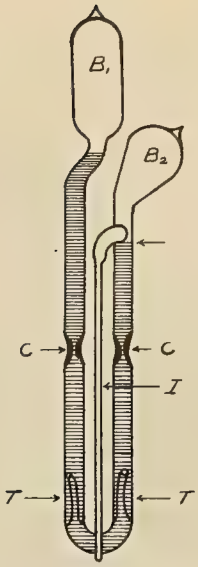


Fig. 5. Principle of the Wright Demand Meter

by the passage of current and in expanding forces liquid into the index tube, where its height as read on a suitably graduated scale indicates the maximum load. After the monthly statement is taken, the instrument is reset by tilting until the index tube is drained. To prevent passage of air from one bulb to the other, capillary constructions are introduced at C and traps at T. A time lag is introduced by the heat capacity of the heater strip, glass, and air.

The characteristic curve of this meter on steady load is shown in Fig. 6. Particular attention is called to the fact that on heavy loads of short duration the indication is largely a function of the capacity of meter that happens to be installed.

The advantages of this meter are simplicity and low cost. Its disadvantages are that it is easily broken in transport; its time interval is short; its indication is proportional only to current and the average

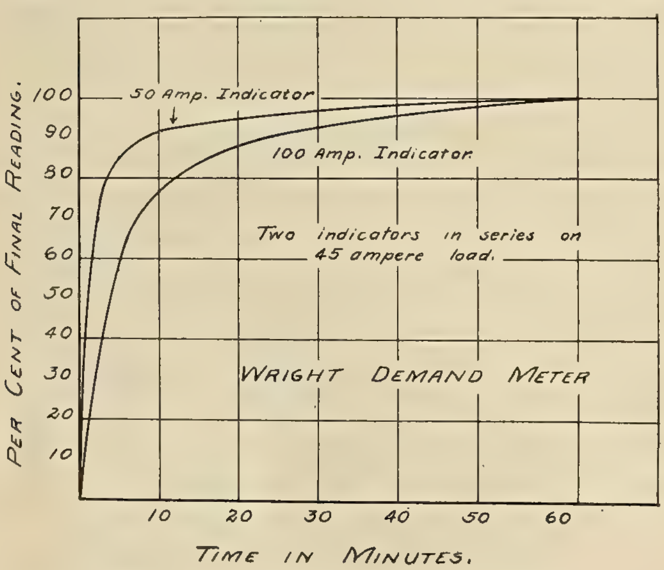


Fig. 6. Characteristic Curve of the Wright Demand Meter

voltage must be assumed if not known; its indication, among other causes of error, is affected by surrounding temperature; it can be used only on direct current or non-inductive a.c. circuits; two meters must be used on a three-wire circuit and their indications assumed to represent a simultaneous demand.

OZONE FOR THE CHILDREN—IV. OR ENGINEERING TWISTERS RETOLD.

"Gentlemen," he said, "I am not an engineer, but I belong to that branch of the public service known as the American Army. We often have many theoretical problems to compute in order to be prepared for the event of war. I have often thought of a contingency in messenger service in the army organization as follows:

"A messenger boy in the rear of an army 25 miles long is sent to the general who is traveling at the head. The army moves forward at the rate of 25 miles per day. The boy, after traveling a uniform speed all day, returns to his post in the rear by nightfall. What distance did the boy travel?"

Let v = speed of messenger in miles per day.

t_x = time it takes in days for messenger to deliver message.

$1 - t_x$ = time it takes in days for messenger to return to rear post.

S_x = distance boy rides to overtake general.

Since the front of the army moves forward at the rate of 25 miles per day, it will travel in t_x days an amount equal to $25\ t_x$. Hence, since the boy travels from the rear to the front

$$S_x = 25 + 25t_x \qquad (1)$$

Also since the boy travels at v miles per day in t_x days he will travel vt_x, or

$$S_x = vt_x \qquad (2)$$

By combining (1) and (2), we have

$$25 + 25t_x = vt_x \qquad (3)$$

$$\text{or} \quad v = \frac{25\ (1 + t_x)}{t_x} \qquad (4)$$

On the return trip the distance traveled back from front to the point at which the rear has advanced is by similar reasoning $v\ (1 - t_x)$. Let the distance of this point from the place where the boy started in the morning be S_y.

$$\therefore S_y = S_x - v\ (1 - t_x) \qquad (5)$$

$$\text{or} \quad S_y = 25 + 25t_x - v\ (1 - t_x) \qquad (6)$$

But it is known that army advances 25 miles in the day's travel, hence this point S_y must be 25 miles from the morning's beginning. Hence by substituting in (6), we have

$$25 = 25 + 25t_x - v\ (1 - t_x)$$
$$0 = 25t_x - v\ (1 - t_x)$$

By substituting from (4), we have

$$0 = 25t_x - \frac{25\ (1 + t_x)}{t_x}\ (1 - t_x) = 25t_x - \frac{25}{t_x}\ (1 - t_x^2)$$

Clearing fractions and dividing by 25, we have

$$0 = t_x^2 - 1 + t_x^2 \text{ or } 1 = 2t_x^2$$

$$\therefore t_x = \frac{1}{\sqrt{2}} = .707 \text{ of a day}$$

Hence, the total distance traveled in 1 day ($t = 1$) = v miles is from equation (4)

$$= 25\ \sqrt{2} + 25$$
$$= 60.25 \text{ miles.}$$

Q. E. D.

THE STANDARDIZATION OF INSULATORS

BY H. S. PERKINS

(Standardization of insulators is a question of vital importance to efficient central station practice throughout the West. The recent discussion at the Riverside convention forcefully brought out this fact. Here is a discussion by a representative of a prominent manufacturer of insulators that adds new light in that the view point of the manufacturer is set forth, thus rounding out this recent discussion so that all view points are now obtainable.—The Editor.)

Is is evident that there are on the market a considerable number of unwarranted pin type insulators for each voltage practiced; while on the other hand it is necessary to have a reasonable number of different designs for each voltage which are individually determined by operating and climatic conditions.

As manufacturers, it becomes difficult for us to determine from the many different designs on the market for any given voltage, just what designs we shall endeavor to standardize on or select as the most practical designs. Most of them undoubtedly have merit from an operating standpoint but it becomes an enigma for us to attempt to pick out the best of them and thereby avoid making all of them.

Manufacturers are interested primarily in producing excellent ware so that the many types mean nothing to them only from an economical standpoint of manufacturing, but general practice has been to leave with the manufacturer, not only the production of the material, but also the question of design and later its guarantee of operation in service. This is apparently on the wrong basis, for with the manufacturer should be left only the difficult position of producing an excellent and high grade ware.

To the operating engineer should unquestionably be left the selection of a proper design for a given installation, but because of the many designs catalogued, and otherwise, by different manufacturers, he is perhaps incapable of determining the proper design for a given installation and this is especially so where such installations present operating conditions different than those he has been intimate with.

Many of the larger class of central stations, we know, have systems which usually give them an incite of three-quarters of the usual operating conditions, normally encountered. Take the operating engineer though, who has a smaller system, operating, for instance, a 40,000 volt line at sea level. When he attempts to run a similar line over a mountain range where the characteristics differ, he is at the mercy of the manufacturer usually, for he depends upon him for the proper recommendation, unless he himself is well versed in the requirements. He can not be guided naturally by his experience in the valley for determining the proper insulator for the mountain range. As a consequence, regardless of whether the manufacturer recommends the type adopted or not, he is blamed for the failure of the insulators if such failure takes place.

Manufacturers, regardless of their engineering facilities, are not altogether capable of determining the proper insulator for most installations. He must be familiar with every organ in the system besides climatic conditions, to be of any real benefit to the operating engineer, under any conditions, in picking out a design.

In conclusion therefore, it is reasonable to believe that if the American Institute of Electrical Engineers and the National Electric Light Association will limit much of their discussion practiced in the past, and design insulators that will meet their particular operating requirements, the manufacturer will be left something definite to work on.

In college professors and research laboratories we have the theoretical talent and in the operating engineer we are presented with facts and practical experience; while the manufacturer is confronted with the possibilities of putting into practice the ideas of both the foregoing and shaping these ideas into a product worthy of the name of porcelain.

If the theoretical talent and the practical talent as represented by operating engineers can get together and actually design shapes suitable for predetermined working pressures under different climatic conditions, there is left with the manufacturer the question of economically producing such a shape with high manufacturing results in view.

The manufacturer can easily determine whether or not his product is properly shaped for economic manufacturing conditions by noting the percentage of loss from each kiln full at the time the finished product is tested. Where the loss is above a reasonable percentage, we will say, and giving the manufacturer a credit for making an excellent product, and understanding his business well, it is reasonable to assume that the design is responsible for the poor results, as shown by the percentage of loss. If this design therefore could be turned back for further consideration to the designers and consistent changes made, an insulator should be produced that can be somewhat standardized on.

With the establishing of standard types for each operating voltage and secondly types for given climatic conditions or otherwise, the operating engineer could easily determine his needs. By doing this the manufacturer can give his undivided attention to producing an excellent product and much of the expressions now in circulation that porcelain is not fit for insulators might possibly be done away with.

There are on the market many excellent insulators and yet many of these designs are still incorrect for any climate other than a dry one or where anything but normal conditions exists. Many of these are types which have lately been adopted by manufacturers as the last word in pin types but others see it different. The time is soon coming therefore when we will have on the market designs other than those already made and the engineering field will again be induced to experiment at a big item of expense, on new types to say nothing of changing the designs previously purchased in good faith and the expense of making new designs limits the amount of money the manufacturer might otherwise expend along ceramic line to better his product.

A manufacturer should spend his money in ceramic research and improvement more than he should for electrical improvements for it needs as much attention it appears as the designing demands.

Manufacturers need assistance from engineers and central station managers in their effort to bring about some plan whereby many of the above steps can be adopted one way or another.

ASSISTANCE IN DEVELOPING FOREIGN FIELDS

BY E. E. PRATT

("Where can I get positive and reliable information regarding engineering development with our foreign neighbors" is a question often asked by the engineer of the West, but few can answer. Here is an article by the chief of foreign and domestic commerce at Washington, D. C., relative to governmental assistance in developing engineering fields in Western South and Central America that should prove invaluable to engineers contemplating the establishment of foreign connections. Few realize the efficient service that is at the disposal of the American engineer simply by personal inquiry and correspondence with governmental authorities at the national capital.—The Editor.)

DR. E. E. PRATT
Chief of Foreign and Domestic Commerce, Washington, D. C.

WESTERN South and Central America offer one of the promising areas for the exercise in the next few decades of the energy, ingenuity, and capital of American engineers. What the individual man is interested in, however, whether he be an engineer looking for opportunities to use his training, a manufacturer of machinery and supplies, or a capitalist seeking openings for investment, is what is the particular field toward which to direct his attention and what facilities are available to enable him to acquaint himself fully with the possibilities there. We will outline these briefly in the present article, stressing particularly the work which the United States Government is doing to furnish this assistance.

It will be well for anyone who expects to become active on the west cost of Latin America to get as accurate an idea as possible of two things, first the geography of the coast countries, and second the spirit and character of the governments and people of these countries. With regard to the first the intelligent inquirer will find an abundance of printed matter covering the general aspect of the Pacific countries of South and Central America, but will find detailed studies hard to encompass. The reason for this is simply that commentators have heretofore been for the most part travelers who were attracted by the more superficial aspects of the regions through which they passed and seldom made concentrated investigations of any particular features. The man who is bent on getting all the data he can with regard to resources, minerals, railroad possibilities, contour of the land, etc., will find a number of sources of information open to him. A good bibliography of Latin American books is published by the Macmillian Company, New York, compiled by Mr. Peter H. Goldsmith director of the Pan American Division of the American Association for International Conciliation. It is usually available at book stores. Various magazines dealing with Latin America will also furnish information as to bibliographies, notably The South American, 61 Broadway, New York, which publishes lists of books on Latin America from time to time and the Bulletin of the Pan American Union, Washington, which has in each monthly issue notices of new books on Latin America. The Pan American Union also answers inquiries fully relating to every phase of Latin American affairs, and has a great amount of printed data of every description, as well as a large collection of photographs, in its library.

For giving oneself a Latin American education along these and other lines, few people realize how much the United States government has been and is doing in the way of furnishing information and getting our people in touch with Latin Americans. These efforts naturally center in trade promotion work, and this is carried on very largely by one Bureau in the Department of Commerce, the Bureau of Foreign and Domestic Commerce. This Bureau should be added to the list of sources of information given above and perhaps should be placed at the head of the list. It would certainly be unwise for any citizen of the United States to go to Latin America on any sort of business mission without first writing to the Bureau of Foreign and Domestic Commerce and learning what data that office had to offer him. For the last two years there has been a Latin American Division in the Bureau which is charged with the duty of giving special attention to inquiries of all kinds, particularly those relating to business ventures, connected with Latin America, and which has on hand a great deal of material available for answering such inquiries. This information is constantly flowing into the Department of Commerce in the shape of consular reports, reports of special agents, government publications from Latin American countries, and periodicals of various kinds dealing with Latin America, and the accumulation of several years, duly classified and indexed, affords a wide range of information available to the general public.

The government's work in promoting trade and investments, however, is not confined to the answering of inquiries. The Bureau of Foreign and Domestic Commerce has an organization that includes, besides the home office in Washington, a number of permanent offices in foreign countries (four in South America and two on the west coast), a string of branch offices in the United States (including one at Seattle and one in San Francisco, and co-operative offices with the chambers of commerce in Los Angeles and Portland), and a corps of traveling agents who make extended investigations and elaborate reports on the various countries they visit, and send samples and photographs of the lines on which they are working. As a recent example of the extent to which the government is working to acquaint our public with Latin America, there were in Lima, Peru, at one time last month one commercial attache stationed there permanently and four special agents, stopping in the city for several weeks on their tours of trade investigation. Besides

the office of commercial attache in Lima there are similar offices in Santiago, Chile; Buenos Aires, Argentina; and Rio de Janeiro, Brazil. Of special interest to readers of this magazine will be the investigations now beng made or already made in the markets for electrical goods, construction materials, ports and transportation, investments opportunities, banks and banking, credit, and prime movers. The agent on electrical goods, an expert formerly in the employ of the General Electric Company, is at this writing in Peru, and will go from there to Bolivia, Chili, Argentina, Uruguay, and Brazil. He will cover not only the present classes of electrical goods to be found on the various markets, with their nationality, prices, and general description, but also the installations of power plants, kind of current furnished, hydroelectric possibilities and developments, electric tramways, and in fact anything and everything electrical that will interest manufacturer, merchant or (within limits) electrical engineer. His reports will be printed as received and will probably cover one country at a time. They can be obtained for a merely nominal sum by writing to the Superintendent of Documents, Government Printing Office, Washington, or by calling at one of the district offices of the Bureau of Foreign and Domestic Commerce.

The best method of procedure for the engineer or the trader who is thinking of making connections with Latin American countries is first, to visit a branch office of the Bureau mentioned, if any is located in his city. There are seven of these, in New York, Chicago, Boston, San Francisco, Seattle, St. Louis, and New Orleans. There he can acquaint himself with the organization, and examine at his leisure the publications of the Bureau. If convenient for him to do so he should visit the offices of the Bureau in Washington, and confer personally with those engaged in Latin American work. He should write or visit the Pan American Union, in Washington, for advise or information such as could be furnished by a traveler thoroughly familiar with the various countries. The staff of the Union is made up of men who have traveled extensively through South and Central America, and who will be glad to answer questions relating to travel facilities, hotels, railway fares, etc., as well as more fundamental aspects of the life of the people. If the inquirer is an engineer and wishes to engage in work connected with his profession, he should get in touch with some of the larger companies operating in South and Central America, such as the J. G. White Construction Company, the Cerro de Pasco Mining Company, the Du Pont Powder Company, the Ulen Contracting Company, the American International Corporation, the Braden Copper Mines Company, the Bethlehem Iron Mines Company, the Chile Exploration Company, W. R. Grace & Company, the United Fruit Company and Moore & Fox, engineers and contractors. It is highly advisable to make connections before leaving this country, and a knowledge of spanish will greatly increase the applicant's usefulness to his employers. If the inquirer is seeking to build up a business with Latin America it will be well for him to arrange to go to the principal countries or to send there a responsible representative, and either arrange for competent representation through native agents or establish his own branch houses. If neither plan is practicable he should send his traveling men to these countries regularly, but before doing so should make very sure of two things—first, that both he and his salesman have as thorough a knowledge of the countries and people as they can get in the United States (and this includes a knowledge of the language), and second that the salesman is of a type that will not antagonize and repel Latin American business men. If he makes friends easily with people of refinement, and has the instincts and manners of a gentleman, he should get on well in Latin America. It is absolutely necessary, however, that he should leave behind him any idea he may have had that the Latin American merchant is easily imposed upon or is unacquainted with matters of quality and price, and he should also get rid of the idea that dissipation in any form is the open door to business in Latin America. A clean-cut, well dressed, good mannered, and sociable gentleman is perhaps more highly appreciated for his genuine good qualities in Latin American business circles than in any other in the world.

WATER FALLS IN CENTRAL AMERICA

(Vast water powers are available throughout the length of the long stretch of the Andes Mountains in Western South America. These powers await only the magic touch of capital and the call of industry to bring their potential possibilities into a concrete reality.)

The government, through its commercial attaches, its consuls, its traveling agents, and its Bureaus in Washington stands ready to give every assistance it reasonably can to every United States firm or individual that contemplates business activity in Latin America or other foreign regions.

VAST SHIP-BUILDING ON PACIFIC COAST

(In the issue of March 15, 1917, a list of the vast shipbuilding on the Pacific Coast was published. This list was taken from the U. S. Commerce Reports. Only six ships appeared as being built upon the Columbia River. Here is an additional list, which shows as a conservative figure that some thirty million dollars in shipbuilding is there under way, comprising sixty ships, eighteen of which are big steel vessels of ten thousand tons displacement.—The Editor.)

Portland

Columbia Engineering Works, Linnton Station

Two wooden auxiliary schooners, one of which is the "Juana Costa," 178 ft. O/A, 156 ft. keel by 36 ft. by 14 ft., twin 200 h.p. Diesel engines, four masts, 1000 tons d.w. cap., for M. T. Snyder, New Orleans, La. Launching and delivery 1917.

Two wooden auxiliary baldheaded schooners, 189 ft. O/A, 167 ft. keel by 36 ft. by 14 ft., four masts, 1100 tons d.w. cap., twin 320 h.p. Diesel engines, for M. T. Snyder, New Orleans, La. Delivery of one May, 1917.

One wooden auxiliary schooner, 247 ft. by 38 ft. by 24 ft., 6 in., twin 320 h.p. Diesel engines for M. C. Keith, New York.

Northwest Steel Co., and Willamette Iron & Steel Works

Four steel steamers, "War Baron," "War Lord," "Vestervard," and "Vestersjod," 425 ft. by 54 ft. by 29 ft. 9 in., 5700 gross tons, 8800 tons cap., 10½ knots geared turbines, coal or oil fuel, three Scotch marine boilers, 210 lbs. S.P., to cost $950,000 each, for Lauritz Kloster, Stavanger, Norway. "War Baron" launched. Delivery of two May, 1917. First two have been bought by Cunard Line.

One steel steamer "Peder Kleppe," 5700 gross tons, 8800 tons d.w., 10½ knots, three Scotch marine boilers, 210 lbs. S.P., for Peder Kleppe, Bergen, Norway.

One steel steamer, "Willy Gilbert," 5700 gross tons, 8800 tons d.w., 10½ knots, three Scotch marine boilers, 210 lbs. S.P., for Willy Gilbert, Bergen, Norway.

One steel steamer, "John Erland," 5700 gross tons, 8800 tons d.w., 10½ knots, three Scotch marine boilers, 210 lbs. S.P., for John Erland, Bergen, Norway. Launching December, 1917.

One steel steamer, 5700 gross tons, 8800 tons capacity, 10½ knots, three Scotch marine boilers, 210 lbs. S. P., for undisclosed Norwegian interests.

Columbia River Shipbuilding Corporation

Eight steel steamers, hulls to range from 250 ft. to 315 ft. overall average d.w. 8800 tons, same as Northwest Steel Co., to cost $1,125,000 each, for Swedish interests. Three of the above vessels to be constructed under the "Isherwood" plan.

Albina Engine & Machine Company

Two steel freight steamers, 261 ft. overall, 251 ft. keel by 43 ft. 6 in. by 20 ft., 2100 gross tons, 3300 tons d.w., for A. O. Anderson & Co., New York, N. Y.

Four steel freight steamers, 261 ft. overall, 251 ft. keel by 43 ft. 6 in. by 20 ft., 2100 gross tons, 3800 tons d.w., for A. O. Anderson & Co., New York, N. Y.

Peninsula Shipbuilding Company

Three auxiliary wooden lumber schooners, "Alpha," "Beta," and "Gamma," 255 ft. 4 in. overall, 238 ft. below propeller, by 43 ft. 4 in. by 21 ft. 6 in., 1600 gross tons, 2600 tons on 20 ft. draft, cap. 1,600,000 ft. lumber, 2 hatches 14 ft. by 32 ft. twin screw, two 300 h.p. oil engines, four masts, for builders' account. Deliveries March, April and June, 1917. Two sold to Bowman Bros., Bergen, Norway, for $500,000. "Alpha" launched December 16, 1916. "Beta" launched March, 1917.

Two auxiliary wooden lumber schooners, 297 ft. 6 in. by 47 ft. by 27 ft., five masted, 2400 gross tons, 4000 tons capacity, two 400 h.p. oil engines, for undisclosed interests.

Standifer-Clarkson Company, North Portland

Two wooden schooners, 220 ft. by 43 ft. by 21 ft., four masts, double-decked, 240 h.p., Skandia semi-Diesel oil engines for salmon transportation, for Libby, McNeil & Libby, "W. F. Burrows" launched April 11, 1917. Designed by C. J. Carlson. Completion, May, 1917.

Two wooden schooners, 220 ft. by 43 ft. by 21 ft., four masts, double-decked, 240 h.p. semi-Diesel engines, for undisclosed interests. Designed by C. J. Carlson.

Supple & Ballin

Two composite wooden, steel reinforced vessels, 4000 tons d.w. capacity, 285 ft. keel, 309 ft. overall, 44 ft. beam moulded, 26 ft. depth moulded. Double diagonal planking, steel top sides, full powered motor ships, twin screws, full Winton Diesel engines, 1000 h.p. Built for Williams & Wigmore, Dover, Del.

St. Helens

St. Helens Shipbuilding Company.

One 5-master, "City of St. Helens," 278 ft. by 48 ft. 3 in. by 23 ft. 3 in., single deck, for lumber cargoes, cap. 2,200,000 ft. lumber, 1830 gross tons, two 320 h.p. Bolinder engines, 8 knots without canvas. Keel laid in two pieces, 22 in. by 24 in. by 134 ft. each, 4 steam winches for handling lumber at rate of 400,000 ft. daily, for the Chas. R. McCormick Co., J. H. Price, Designer. Launched January 16, 1917.

One auxiliary powered schooner, "S. I. Allard," 276 ft. by 48 ft. by 24 ft. 5 in., 1870 gross tons, capacity 2,200,000 ft. lumber, for the Chas. R. McCormick Co. Launching, March, 1917.

One wooden schooner, "Frank B. Stout," 206 ft. by 43 ft. by 16 ft., 495 gross tons, two 320 h.p. Bolinder engines, passenger accommodations, 650,000 ft. lumber, Hough steel cargo rig., for the California & Oregon Lumber Company, Brookings, California. To cost $135,000.

Architect of schooners for Chas. R. McCormick Co., is J. H. Price.

Astoria

McEachern Shipbuilding Company

Seven auxiliary schooners, 250 ft. by 43 ft. by 21 ft. 6 in., four-masted, 2000 tons d.w., three hatches, fitted with two double electric winches, 1,750,000 feet lumber, fuel oil capacity for 7000 miles, two 240 h.p. direct reversible Skandia oil engines, for A. O. Anderson & Co., New York City. Jas. A. Sloane, Seattle, naval architect. Launchings January to November, 1917, inclusive.

One wooden motor ship, "Maid of Douglas," 250 ft. by 43 ft. 6 in. by 21 ft., 240 h.p. semi-Diesel engines, capacity of 1,600,000 feet lumber below decks, for the citizens of the state of Oregon. Ordered by Arthur C. Callan, Portland, Oregon.

Two wooden auxiliary schooners, 266 ft. by 43 ft. by 22 ft., 2100 d.w. capacity, 2,000,000 ft. lumber, 320 h.p. Bolinder oil engines, for A. O. Anderson & Co., New York City.

Wilson Brothers

Two auxiliary wooden schooners, 225 ft. by 40 ft. by 16 ft., 1000 gross tons, cap, 1,200,000 feet lumber, 825 h.p. trip. exp. engines, sublet by the St. Helens Shipbuilding Co., launching of "Latourell" January 15, 1917. "Wahkeena" already in service.

North Bend

Kruse & Banks

One wooden schooner, "Florence Olson," 235 ft. overall, 215 ft. keel by 42 ft. by 16 ft. 5 in., engines 13½-23-40 by 30, Babcock & Wilcox boilers, 1,250,000 feet lumber, to cost $200,000; for lumber trade. For Oliver J. Olson Co.. San Francisco, Cal.

One wooden steam schooner, "Nann Smith," 266 ft. by 50 ft. by 18 ft., capacity 2,000,000 feet lumber, Scotch boilers, turbine engines, oil burning, to cost $225,000, for the C. A. Smith Lumber Co. Delivery February, 1917.

One wooden steam schooner, "Horrace Baxter," 235 ft. overall by 215 ft. keel by 42 ft. by 15 ft. 6 in.; capacity 1,250,000 ft. lumber, to cost $200,000. For J. H. Baxter & Co., San Francisco, Cal.

MERCHANDISING ELECTRICAL ENERGY

(In the merchandising of electrical energy the subject of auxiliary reservoirs and their period of operation has considerable influence upon the economic use of water and especially does it affect the rate that may be granted for electric power supply. This matter is discussed in the following lines by the commercial engineer for the Southern Sierras Power Company in the Riverside district where the economic use of the auxiliary reservoir is playing a most important role in the placing of power sales for the central station and at the same time in the development of the communities served.—The Editor.)

RESERVOIRS AND THEIR OPERATION

By ROSS B. MATEER

Too high a value cannot be placed upon the reservoir used in connection with the small motor operated pumping plant by the now successful rancher and who has progressed from a state approximating bankruptcy to comparative affluence. The many advantages of the storage basin appeal to him and none perhaps more than the, first, saving in initial investment, second, the fixed and equitable operating expense and third, the large yield per acre cultivated, and a result of (a) adequate irrigation and (b) flexibility of head.

Plant Investment.—Is the aggregate of expense incident to the cost of the motor and the pump, the installation of the motor driven unit and the construction of the reservoir in comparison with the high capacity pump driven with the "barking" oil engine or the large electric motor. All direct connected, centrifugal equipments installed in either redwood or concrete curbed pits and suitable for efficient service on properties heretofore watered by the large vertical, belt driven units permit of a saving in actual cash equal to, in many cases, a sum sufficient to construct an oil sealed earthen storage basin of ample capacity to conserve the water pumped by twenty-four hours continuous operation of the plant, and where the expense of a small motor driven unit is balanced against the fuel engine equipment a greater saving in first cost is evident, as heretofore referred to.

While the large plant is in service from thirty to fifty per cent of the regular irrigating season and at a rate per kilowatt hour commensurate with the load factor accorded the utility the small motor driven unit is in operation throughout the regular season or the entire year at a fixed or flat rate charge per h.p. of maximum demand equivalent to from sixty-two (62) to thirty-eight (38) per cent of the average meter rate charged for intermittent service, according to the number of consecutive months of use. In fact an aggressive public utility recently presented to its consumers the option of two methods of charging for all service rendered under its unit h.p. of maximum demand charge, either, first the designation in advance of the season of a certain operating period or second a graduated flat unit charge per h.p. of maximum demand according to the length of the season, as follows:

First Option

No. 1—12 months' service at $50.00 per year per h.p. of maximum demand, being equivalent to $4.166 per h.p. per month.

No. 2—11 months' continuous service at $49.00 per year per h.p. of maximum demand, being equivalent to $4.454 h.p. per month.

No. 3—10 months' continuous service at $48.00 per year per h.p. of maximum demand, being equivalent to $4.80 per h.p. per month.

No. 4—9 months' continuous service at $47.00 per year h.p. of maximum demand, being equivalent to $5.222 per h.p. per month.

No. 5—8 months' continuous service at $45.100 per year per h.p. of maximum demand, being equivalent to $5.625 per h.p. per month.

No. 6—7 months' continuous service at $42.00 per year per h.p. of maximum demand, being equivalent to $6.00 per h.p. per month.

No. 7—6 months' continuous service at $38.00 per h.p. of maximum demand, being equivalent to $6.333 per h.p. per month.

No. 8—5 months' continuous service at $33.00 per year per h.p. of maximum demand, being equivalent to $6.60 per h.p. per month.

No. 4—9 months' continuous service at $47.00 per year per h.p. h.p. of maximum demand, being equivalent to $6.75 per h.p. per month.

Second Option

Payment to be made on the following monthly basis: For the first month of service at $7.50 per h.p. of maximum demand.

For the second month of continuous service at $6.75 per h.p. of maximum demand.

For the third month of continuous service at $6.50 per h.p. of maximum demand.

For the fourth month of continuous service at $6.25 per h.p. of maximum demand.

For the fifth month of continuous service at $6.00 per h.p. of maximum demand.

For the sixth month of continuous service at $5.00 per h.p. of maximum demand.

For the seventh month of continuous service at $4.00 per h.p. of maximum demand.

For the eighth month of continuous service at $3.00 per h.p. of maximum demand.

For the ninth month of continuous service at $2.00 per h.p. of maximum demand.

For the tenth month of continuous service at $1.00 per h.p. of maximum demand.

For the eleventh month of continuous service at $1.00 per h.p. of maximum demand.

For the twelfth month of continuous service at $1.00 per h.p. of maximum demand.

The second option is generally chosen and results in the intelligent rancher watering his land throughout the entire year with a corresponding increased yield per acre under cultivation.

Considering the water level to remain normal and the horsepower input determined, the expense per season becomes a fixed equitable sum, which like the interest on the mortgage can be anticipated and provided for in the year's budget. Under the fixed charge per horsepower of demand water many times the quantity sparingly pumped under a meter schedule is available for irrigation purposes without the uneasiness

sometimes experienced as to the size of the monthly statement.

Again, if you please, consider the fairness of the flat unit charge per horsepower of demand from an analysis of conditions before and after, the change in plant equipment and construction of the storage basin and as noted in a district where the lift is high and alfalfa requiring over five hundred tons of water for each ton of hay marketed is the staple crop. Here with 1013 h.p. installed for the stinted watering of 2055 acres of alfalfa or 2.03 acres per h.p., the average expenses per season were $23.80 per horsepower connected or $11.75 per acre cultivated.

Apparently hopelessly in debt yet grasping as it were, at a straw, the change in equipment was sanctioned with gratifying results to farmers and the utility. The averages of an equal number of consumers operating from five to twelve months being forty-three dollars and thirteen cents per horsepower per year with an equivalent rate per kilowatt hour of one and two hundred ninety-five thousandths cents and a possible rate had a high seasonal load factor been maintained of nine hundred eighty-two thousandths of a cent. The cost per acre per season was eleven and one-half dollars with a continuous flow throughout the period operated of six-tenths of an inch.

Profits.—That scientific ranching is productive of a good profit is illustrated by the returns on a certain eighty acre tract, seventy-seven of which are planted to alfalfa. Through the season of 1916, ten hundred thirty-seven tons of alfalfa were grown at an expense of $1784 for water in an eight month period or at a unit cost of $1.72 per ton of hay. Of the total tonnage 877 per marketed for $12,175, yielding to the owner a profit of $9000. Conclusive evidence that a ranch will produce abundantly when, first, the soil is adapted for the growth of the crop chosen; second, the land is properly leveled and checked and third, when a small quantity of water is pumped at a reasonable expense and with an efficient plant to a large storage basin from which water can be drawn in such quantities as the soil and the growth of the crops demand.

It appears therefore that the problem confronting the quasi public utility engaged in the marketing of "juice" for agricultural purposes is largely the education of the rancher, not alone in scientific farming but in the duty of water and the methods of lifting it from subterranean basins with a minimum plant investment and an operating expense commensurate with the returns on the tonnage grown. Is not the solution of the problem the use of the small motor driven plant and the storage basin in lieu of the large equipment of poor load factor and which calls for repeated reductions in metered service to temporarily hold a consumer on the system?

When ordering electrolyte for storage cells the type of battery should always be specified since electrolyte, which is suitable for stationary batteries, is not generally best for self-starter and ignition batteries. The best results are obtained by using electrolyte of the proper specific gravity.

LONG DISTANCE SUPPLY OF ELECTRICITY IN GERMANY

BY CHAS. S. WINANS

(In view of the generally accepted high standing of German efficiency in industrial development, here is an article on hydroelectric activity in Germany that should prove for purposes of comparative study of unusual interest to engineers throughout the West. These data were collected recently by the American Consul at Nuremburg, Germany, and are just being made available for public disposition through the U. S. Commerce reports.—The Editor.)

The Prussian Government is considering the project of constructing a long-distance power plant in the neighborhood of Hanover, in order to accomplish a double purpose—(1) to aid the Deister coal-mining industry by using the coal in the proposed plant; (2) to obtain the power necessary to realize the contemplated connection of the district supplied by the State Oberweser power plants with the district supplied by the state power plant at Dowerden, so as to create on a practical, economic basis a continuous region of electrical supply extending from Bremen to Hanau. This project is also intimately related to the construction, in consequence of the proposed canalization of the Main, of reservoirs for the generation of electrical power at Mainkur, Kesselstadt, and Gross-Krotzenburg. The available water power of the Main in this district, which is estimated at a yearly output of 25,-000,000 to 30,000,000 kw.-hr, will be used partly for supplying the district of Hanau, Gelnhausen, Schluchten, Fulda, Gersfeld, and Hunfeld, and will be partly conducted at a high tension to other power plants.

Herr Besk, in concluding his summary of the present status of the governmental supply of electricity in Germany, observes:

These large-scale preparations for a uniform supply of electricity under the supervision and financial co-operation of the state offer a guaranty that in the near future electrical current will be placed at the disposal of industry and agriculture under the most favorable conditions. By the long-distance supply from state power plants, which will be constructed within reach of water power or coal beds, the status of the local electrical works and the overland central stations will not be endangered. Instead of undertaking expensive enlargements these will cover their extra need of current from the long-distance plants. The transformation and distribution to the consumers remain, as before, a matter for the local works. They appear to a certain extent as intermediate dealers in electricity.

Through the uniform electrical supply of whole countries a compensation in the demand for power will be assured, with the possibility of utilizing all plants more uniformly and economically than before, when many local works at times had excessive demands made upon them, while at other times they had to supply only a small quantity of current. Regardless of other savings in a comprehensive organization of electrical production and distribution, one may not, from the standpoint of political economy, disregard the circumstance that our natural sources of power and land resources will not be squandered by careless working, but will be exploited in a productive and suitable manner for the general welfare of the country.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(Cost of repairs for polyphase motors is a subject upon which accurate information is desired from many quarters, compilation of cost data from a large number of repair jobs have been made and tabulated in the following lines. Other subjects, too, are treated, such as notes on portable devices, cables and connections followed by discussion of new nomenclature for desk fans. This department is conducted by a well-known power apparatus specialist actively engaged upon the problems discussed herein with a large electrical supply house in San Francisco and as a consequence their value to the contractor and dealer should be of unusual merit.—The Editor.)

COST OF REPAIRS FOR POLYPHASE MOTORS

At the request of a number of our readers we are reproducing a part of a table showing the approximate cost of repairs for polyphase motors used originally in connection with an article by the writer which appeared in the January 1, 1916, issue of the Electrical Review and Western Electrician. This table has been revised to take into account the increased cost of the materials entering into such repairs and therefore bring the estimates more in line with the present cost of this work. The subject matter of the original article is given in the following paragraphs in a condensed and slightly changed form.

The table is suitable for 60-cycle two or three-phase squirrel-cage motors wound for any of the standard voltages from 110 to 550 inclusive.

Cost of Repairs for 60-Cycle Polyphase Motors

Horsepower	Synchronous Speed in R.P.M.	Frame Size	Stator Winding	Resoldering Rotor	Bearing Linings, Per Set of Two	Painting	Recrating
.5	1200	C	26.25	2.50	1.35	1.00	1.00
.5	1800	A	24.25	2.25	1.35	1.00	1.00
.75	1200	E	28.00	3.00	1.85	1.00	1.00
.75	1800	B	24.25	2.25	1.35	1.00	1.00
1	900	G	34.75	4.00	3.10	1.50	1.50
1	1200	F	28.50	3.00	1.85	1.25	1.00
1	1800	C	26.25	2.50	1.35	1.00	1.00
1.5	1200	G	34.75	4.00	3.10	1.50	1.50
1.5	1800	E	28.00	3.00	1.85	1.00	1.00
2	1200	G	34.75	4.00	3.10	1.50	1.50
2	1800	F	28.50	3.00	1.85	1.25	1.00
3	900	I	53.50	6.50	5.25	1.50	1.50
3	1200	H	48.50	4.75	3.55	1.50	1.50
3	1800	G	34.75	4.00	3.10	1.50	1.50
5	900	K	73.75	8.75	8.05	1.75	2.00
5	1200	I	53.50	6.50	5.25	1.50	1.50
5	1800	H	48.50	4.75	3.55	1.50	1.50
7.5	900	L	70.75	12.00	7.85	2.00	2.50
7.5	1200	J	59.50	7.00	6.60	1.75	2.00
7.5	1800	I	53.50	6.50	5.25	1.50	1.50
10	900	M	75.00	13.25	7.85	2.00	2.50
10	1200	L	70.75	12.00	7.85	2.00	2.50
10	1800	J	59.50	7.00	6.60	1.75	2.00
15	720	P	93.75	15.50	10.25	3.00	4.00
15	900	N	71.25	14.25	10.25	3.00	4.00
15	1200	M	75.00	13.25	7.85	2.00	2.50
15	1800	K	73.75	8.75	8.05	1.75	2.00
20	600	S	156.25	19.00	12.10	3.25	6.00
20	900	P	93.75	15.50	10.25	3.00	4.00
20	1200	N	71.25	14.25	10.25	3.00	4.00
20	1800	M	75.00	13.25	7.85	2.00	2.50
25	600	S	156.25	19.00	12.10	3.25	6.00
25	720	S	156.25	19.00	12.10	3.25	6.00
25	900	R	143.75	17.75	12.00	3.25	6.00
25	1200	P	93.75	15.50	10.25	3.00	4.00
35	600	T	187.50	20.50	19.95	3.50	6.25
35	720	S	156.25	19.00	12.10	3.25	6.00
35	900	S	156.25	19.00	12.10	3.25	6.00
35	1200	R	143.75	17.75	12.00	3.25	6.00
50	600	V	218.75	21.75	30.85	3.50	6.25
50	720	V	218.75	21.75	30.85	3.50	6.25
50	900	T	187.50	20.50	19.95	3.50	6.25
50	1200	S	156.25	19.00	12.10	3.25	6.00

For most of the sizes listed the costs were arrived at by taking the average cost of repairs for a given frame and then applying this cost to the various ratings built in that frame. This will be apparent by comparing the costs for the different ratings. Take for example, frame G. The cost of rewinding the stator is $34.75. This figure has been applied to the following ratings all of which are built in that frame: 1 horsepower, 900 revolutions per minute; 1.5 horsepower, 1200 revolutions per minute, and 3 horsepower, 1800 revolutions per minute. The frame sizes specified do not apply to any particular line of motors, but were arbitrarily chosen for the purpose of this article. However, the relative output of a given frame at the different speeds will be found to agree quite closely with several lines of induction motors on the market.

These estimates may also be used equally well for motors of other frequencies by taking the figures applying to a 60-cycle rating built in the same frame. This comparison can be easily made by referring to the manufacturer's rating and dimension sheets for that particular line of motors. The tables may be further applied to slip-ring or phase-wound motors, since the cost of rewinding the rotor of such a machine will not differ materially from the cost of rewinding its stator. On this basis the cost of completely rewinding a 10 horsepower, 1800 revolutions per minute slip-ring motor built in frame J will be $119, or $59.50 for the rotor or stator separately.

The estimates for rewinding the stator or resoldering the rotor do not include any preliminary work required to put the stator structure in fit condition to receive the new winding or work required on the rotor before the actual resoldering can be started. In other words, the figures cover only the actual rewinding or resoldering, as the case may be. However, this preliminary work is frequently necessary and must always be considered in making up estimates. It is due to a number of causes.

For example, the motor bearing linings may have worn down sufficiently to allow the rotor to rub against the stator. If the motor has operated very long in this condition the laminations of either or both stator and rotor will probably be damaged, which may require considerable work to put them into their original condition. Again, a defective or broken bearing may injure the shaft. Sometimes this damage will be serious enough to require a new shaft. New bearing linings will probably be required in either case. Burned-out windings may also be accompanied by fusing of parts of the stator laminations. These fused portions must necessarily be removed before actual replacement of the coils can be commenced.

In a rotor which has been badly overheated, allowing the melted solder to be thrown out, arcing is frequently set up between the rotor bars and end rings, causing serious burning. When this occurs, new end rings are often needed, either for one or both ends of the rotor, or perhaps part of the bars will need to be replaced. With bolted end-ring construction there is also liability of trouble. The expansion of the end rings, caused by the excessive heat, tends to snap the bolts between the rotor bars and rings, producing the most favorable conditions for arcing. Burnouts of this kind, for either soldered or bolted construction, are quite common in connection with motors which have been started from time to time under loads requiring heavy starting torque with long periods of acceleration. Two or three-phase motors allowed to operate single-phase for any considerable length of time may also develop troubles of this nature. Very often the rotor will be badly damaged, while the stator has been only slightly overheated. Conversely, in some instances, the stator will be burned out, while the rotor is uninjured.

From these points it will be clear that estimates should not be made until after the motor has been given a careful inspection, otherwise there is likely to be a large discrepancy between the estimated and actual cost of the work. If an inquiry of this kind must be handled by letter it is not possible to make an inspection, but the dealer can at least detail clearly just what his estimate covers and point out the possibility of additional work that may be needed. Our readers will appreciate that estimates of this kind can be only approximately correct at the best. However, the table has been carefully compiled from data based upon a large number of actual repair jobs and it is believed these estimates will be found quite conservative.

NOTES ON PORTABLE DEVICES, CABLES AND CONNECTORS

Portable electric devices or appliances such as drills, hammers, grinders, lamps, motors and the like are probably handled with less care and precaution than any other class of electric apparatus. Especially is this true as regards the safety of the operator. Generally little attention is paid to the cords or connections until they give trouble. The cords are allowed to wear until they break or burn off. Then they are spliced and taped in a careless manner. Frequently the cords are allowed to lay on damp or wet floors or are hung on grounded pipes or machines. The connectors may have exposed live ends and are often of such design that the terminals are constantly under strain and therefore quite likely to be pulled out, loosened or broken off.

Many of these devices are operated from light or power circuits on which the voltage to ground does not exceed about 125 volts so there is not a great deal of danger from shocks. Still there is always the possibility of burns from arcs caused in handling connectors or from broken or burned cords. There is also an increasing tendency to operate portable tools from power circuits probably to take advantage of the more favorable rates. In fact the writer has noticed a marked increase in the demand for 220 volt tools during the past year. On most of these power circuits the voltage to ground exceeds 150 volts so it seems more caution should be observed in handling such portable devices as may be operated from these circuits. There are other chances of accidents due to defective cords or connectors which are generally not given thought. For example suppose a mechanic is working alone in the vicinity of a machine consisting of a number of moving parts located in a restricted space with a portable lamp as his only source of light. If the light becomes extinguished for any reason whatever there is always some chance of the workingman coming in contact with the moving parts of the machine. So from every point of view substantial, well insulated cords and portables are desirable especially when connected to power circuits.

The Bureau of Standards has realized the need of more care in handling these devices and have accordingly included rules to indicate the cautions which should be observed where the use of portables is necessary in the National Electrical Safety Code just recently issued.

These same rules in a slightly modified form are incorporated in the Electrical Utilization Safety Orders issued by the California Industrial Accident Commission. These orders became effective January 1, 1917. The general order covering these points is No. 729 entitled Pendants and Portables which reads as follows:

> Pendant or portable conductors shall not be installed or used on circuits operating at over 150 volts to ground, unless they are of a type suitable for the voltage and conditions, and conform to the requirements of Orders Nos. 761, 762, 763, and 764.

Electrical dealers, contractors, salesmen and others interested should take advantage of every opportunity to bring these orders to the attention of the proper persons in industrial plants, mines, garages and other similar industries in which portables of the various types are largely used. Dealers should also arrange to carry a reasonable stock of the better grades of portable lamp guards, plugs and cords. By following these two suggestions dealers should be able to considerably increase their business along these lines, at the same time doing their customers a good turn by selling them material which complies with the law instead of allowing them to select something which may at any moment be condemned.

NEW NOMENCLATURE FOR DESK FANS

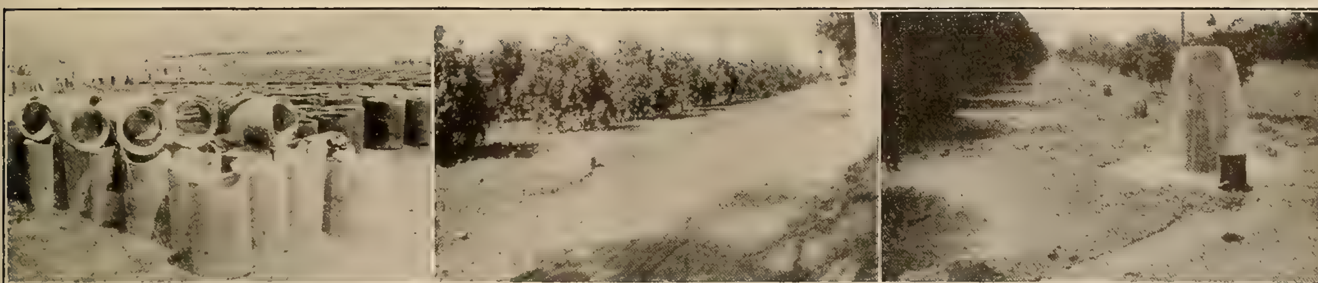
The old term "desk and bracket" formerly applied to certain types of fan motors has been superseded by the term "non-oscillating." This will give two general groups of fans, oscillating and non-oscillating. These terms have been quite generally adopted by the various fan manufacturers in making up their 1917 catalogs and will without doubt greatly simplify the handling of fan business.

Dealers, salesmen and others interested are urged to adopt these terms at once and further to explain them at every opportunity to the layman. It is only by the combined efforts of the electrical fraternity in general that the best results of such standardization can be quickly obtained.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Concrete piping is coming more and more into use as the economic development of water supply in the West proceeds to higher development and more scientific utilization. The auxiliary reservoir continues to dovetail in the economic operation of electrical pumping plants. Both these matters are discussed in the following pages, the former by a well-known irrigation investigator at the University of California and the latter by the commercial engineer for the Southern Sierras Power Company at Riverside.—The Editor.)



A. Stands Before Placing B. Stands in Overflow System C. Pressure Causing Overflow of Control

Fig 1

CONCRETE STANDS FOR FURROW IRRIGATION

Some of the forms of concrete stands used in irrigation with concrete pipe distributing systems are shown in the accompanying illustrations. In Fig. 1-A stands made to saddle over the supply line are shown in the pipe yard. These have four openings in which the spout gates will later be placed. The pressure valves will also be set in the stand to control the flow from the supply line. In Fig. 1-B stands for the overflow system are shown, each group of 4 or 5 stands being set with their tops level and controlled by an overflow stand at the lower end of each set. Fig. 1-C shows the control stand of a pressure system. The controlling valve is set in the elevated stand. The height of the stand should be greater than the pressure head in the pipe line. In this case the pressure exceeds this height and overflow is resulting.

In Fig. 2 three types of stands used with the pressure system are shown. In Fig. 2-A, the stand is capped and the spouts placed on the outside. The pressure is outward on the slide spout gates so that heavier gates are required than for the usual open top stands. With capped stands there is also more difficulty from stoppage by leaves should such get into the water. Fig. 2-B shows a stand having an enlarged top of 16 in. pipe in which outlets for 6 furrows are placed. The control valve is placed at the top of the riser pipe from the supply line. Fig. 2-C shows a form of stand having a semi-circular top of 30 in. diameter for 4 furrows. This type of stand is frequently found in the vicinity of Whittier but is not used to any extent in new installations at present.

SMALL IRRIGATION PUMPING PLANTS WITH AUXILIARY RESERVOIRS

BY C. REMSCHEL

In the district near MacFarland and Wasco the principal crop irrigated is alfalfa. For this crop relatively large irrigation heads give much better results in flooding. The lifts vary from 40 to 60 ft. Electric power rates are based on a flat rate per horsepower per year. This combination of conditions has led to the use of small sizes of pumps with earth reservoirs. The pumps are set in pits near to the elevation of the water in the wells and direct connected to the motors. The average of the plants visited showed a capacity of about 4 g.p.m. of pump capacity per acre handled with these pumps and reservoirs. Where reservoirs are not used a capacity of 10 g.p.m. or even larger is usual.

With few exceptions only one well is used with each pump. These wells are from 100 to 150 ft. deep, 12 inch casings being generally used. The cost of such wells in this district, including casing, has been:

A. Pressure Stand Capped B. Six Distributing Gates C. Large Semi-Circular Pressure Stand

Fig. 2

Up to 100 ft.	$2.50 per ft.
101 to 200 "	3.00 " "
201 to 300 "	3.50 " "
301 to 400 "	4.00 " "
401 to 500 "	4.50 " "

The pits are usually circular in shape and 6 or 7 ft. in diameter. Some use rectangular pits having about the same area. The lining consists of a heavy floor on which the pump is set, a concrete wall 3 or 4 in. thick and about 2 ft. high, and a thin plaster lining to the surface. This thin lining is constructed by lightly plastering the surface of the soil with mortar on top of which a coat of one part cement to four parts of sand about one inch thick is placed. Such pits are dry and clean and prevent dirt or water from getting into the pump or motor. No definite cost figures could be secured for such linings, the cost however is relatively low.

On account of the nature of the soil the water does not percolate through the ground very rapidly and the wells do not have a great pumping capacity. When pumping the vacuum is high which with a usual lift above the surface of from 4 to 8 ft. gives a total actual working lift of from 45 to 75 ft.

The use of reservoirs is general except for the large plants pumping from 100 to 200 miners' inches. Such large plants operate continuously. With reservoirs an irrigating head of 300 to 400 in. can be secured for the time used in actually irrigating and a much more efficient distribution of the water secured. Some owners claim that such streams give from 25 to 50 per cent better results than streams of 75 to 100 inches.

The reservoirs used are rectangular, generally square, varying from 90 by 90 to 200 by 200 ft. The usual depth of water held is 4 ft.; with some of the larger ones the depth is 5 ft. It is considered desirable that a reservoir have sufficient capacity to store at least 24 hours pumping.

The reservoirs in the vicinity of MacFarland and Wasco are comparatively easy to build as the soil holds water well. The excavation from the inside is used to make the banks. Where the soil contains sufficient sand so that seepage is excessive, the reservoirs are puddled with about 16 inches of manure trampled down by stock. To excavate a reservoir 200 by 200 ft. with banks 5 ft. high requires two 2-horse Fresno scrapers for about 10 days.

One reservoir in sandy soil which had been oiled was visited. When new before oiling the seepage was at the rate of about a foot in depth per day. After oiling it lost only 7 inches of water by seepage and evaporation in six weeks at the end of the irrigation season. This reservoir was 240 by 70 ft. and 4 ft. deep. The cost for excavation was $54, a four-horse scraper being used for 9 days. The oiling cost $135 for 155 barrels of oil and $101 for hauling, applying the oil and fixing the banks, a total cost of $290.

These plants are under the system of the San Joaquin Light & Power Company. The rates most generally used were $50 per horse power per year based on the tested load, this has now been changed to $42.30 per horse power per year based on the connected load. Owing to the high load factor when operated with reservoirs the equivalent rates per kilowatt hour are quite low. The following records are representative of the equivalent rate per kilowatt hour used when operating under the former $50 rate.

Size of Motor Horsepower	Number of Plants Examined	Average Equivalent Rate per kw.-hr. in cents
3	6	2.38
5	6	1.05
7½	6	1.24
10	6	1.08
15	6	1.01
20	3	.91
25	3	.84
30	3	1.06

The natural tendency of those constructing pumping plants is to install pumps of sufficient capacity so that operation for only a portion of the time will be required. This results in a low load factor for the use of power and a high rate per kilowatt hour if the rates for power used in irrigation are to return the cost of such service. The small plant operated continuously can be made to be of advantage to both the consumer and the power company. The first cost of construction of the smaller capacity plant with a reservoir will not be materially different from that of a plant without the reservoir but having a larger size of pump. With the smaller sized pump the draw down while pumping is usually less giving smaller total lifts. The smaller pumps have lower efficiencies than the larger one, this loss will frequently be balanced by the less lift. With reservoirs the company secures a more uniform load with a high load factor during the months when irrigation is practiced.

TEST OF DEEP WELL TURBINE PUMP

A 15 in. type CLC 5-stage, 110 ft. Layne & Bowler pump has been tested by the Arizona Experiment Station under the direction of G. E. P. Smith, the results being published in the twenty-sixth annual report. The pump was set in a well with the bottom of the bowls 28.5 ft. below the normal water level. Thirty feet of 6 in. suction pipe were attached below the pump bowls while above were 105 ft. of 7⅝ in. column pipe and the pump head, the discharge outlet being 86.3 ft. above normal water level.

The pump was belt-connected to a 30 horsepower motor. A watthour meter was used to measure the input to the motor and the motor efficiency determined for various loads with a Prony brake. The belt, including a quarter turn, was assumed to have a loss of 8 per cent. The draw down was determined with an electric tester and steel tape. A pressure gage was installed just below a gate valve on the discharge, the sum of the pressure gage reading and the static head being taken as the total head. The discharge was measured over an 18 in. weir. The discharge and head were varied by means of the gate valve in the discharge pipe. The results of the test are given in the accompanying table:

Test of 15-inch Deep Well Turbine Pump

Pump Speed r.p.m.	Total Head feet	Discharge g.p.m.	Efficiency per cent
903	91.1	301	64.2
1031	136.1	250	60.6
1030	127.7	338	75.4
1019	108.6	417	71.4
1242	97.1	717	55.2
1225	154.9	535	66.8

The comment is made that "the tests show that a very high efficiency can be obtained with this type of pump if the pump is working under its best conditions of head and discharge, but that at other heads or other discharges the efficiency may be low. This emphasizes the importance of knowing the operating conditions in advance and of buying a pump especially designed for those conditions."

PACIFIC COAST SECTION N. E. L. A. CONVENTION

(The Pacific Coast Section of N. E. L. A. was extremely fortunate in having for its leadership at the incipient meeting an unusual array of constructive talent to pilot the initial journey in organization into safe and peaceful waters. The President's address, given below, should assist our readers throughout the West in conveying some of these masterly measures of preparation that are necessary for the successful consummation of a gathering of such magnitude as that recently held at Riverside. Other interesting features of this remarkable gathering follow this report.—The Editor.)

THE PRESIDENT'S ADDRESS

BY R. H. BALLARD

Marking an epoch in the industrial and commercial development of the West and Southwest, Pacific Coast Section of the National Electric Light Association convenes for its first annual meeting today. Here we see the realization of our long treasured dream—the formation of an association in this section of the country which, while embracing the ideals and underlying principles of the National Electric Light Association, also provides means for the proper application of those principles to our special conditions. Not until the National Association's convention in San Francisco did the conception begin to take definite shape. On that occasion the concerted effort of western representatives resulted in greater recognition of western interests in the councils of the National Association and at the same time gave the needed impetus to make the Pacific Coast Section an accomplished fact. Organization was perfected at a meeting held in Los Angeles on January 6, 1917, and the enthusiastic welcome accorded the Pacific Coast Section tion in all fields of its activities is the best evidence of its present need and future usefulness.

R. H. BALLARD

(The first president of the Pacific Coast Section, N. E. L. A.)

Membership

The wonderful work performed by the membership committee in the three and one-half months of our existence will be apparent to you from its report. It sets a mark for rapid organization. In our organization, particular attention has been given to the manufacturing, jobbing and contracting interests to develop a unity of effort within our area of operation and the response in membership from these interests has been quite gratifying. Their representatives have also met with us in committee work and it will be proposed to you at this meeting that hereafter they be represented on the executive committee. Conditions in our section of the country demand a close relation between all branches of the industry and it develops upon us to lead the way.

Aims and Purpose of Pacific Coast Section

It is but natural that outside of our organization there has been considerable speculation as to our purpose and aims. In other words, what and why is the Pacific Coast Section? Is it to combat municipal ownership—to resist regulation—to create or foster illusionary ideas regarding the duties and responsibilities of its members in their capacities as public servants? Does it embody ideas in conflict with the accepted principles of constructive economic and industrial development? What is it and why?

Briefly, the object of the association, as stated in its construction, is to promote the interests of its members, establish cordial and beneficial relations with the public and kindred associations and advance scientific and practical knowledge in all matters relating to the industry. In promoting the interests of its members, the association is encouraging the development of the electrical business as it directly affects its members.

One of the functions of the section is to serve as a clearing house for the ideas and experiences of its members. Instances are constantly arising where the larger companies must go to the smaller companies for ideas, suggestions and assistance in certain matters and, perhaps in more frequent cases, the smaller companies seek counsel in their problems from the larger companies. The advantage of a centralized and accessible source of information, where the experiences and problems of all companies, both large and small, are constantly being collected and arranged for quick reference, is obvious and we have now such a source of information and bureau for the interchange of views between members in this organization.

This organization stands emphatically and unequivocally for closer relations and broader understanding between the utility companies and the public and will work unceasingly to that end. It will encourage educational, co-operative and harmonious action among its members and while the officers and committees cannot do more than suggest policies to member companies, they can emphasize the principles of the National Electric Light Association, which include the full performance of duty to the public in providing good service at reasonable rates, with liberal extensions into new territories. The Pacific Coast Section will lend its assistance and influence to promote amicable relations between the electrical industry and the public, and at all times frankly co-operate with the regulating bodies.

Committee Reports

During these two days of business, our time will be well occupied with an exceptionally fine program of business sessions, which I urge every one to attend. Our committees have done excellent work in the short time at their disposal and the members have labored assiduously at their tasks, compiling excellent papers for discussion. I hope each member will consider it his special privilege to speak his mind during the sessions.

Commercial Committee.—Recommendations contained in the report of the commercial committee are worthy of your serious consideration:

(a) That the association lend its support to other organizations in the promotion and advertising of the electric business;

(b) That the large member companies lend assistance to the small companies in the securing of trained men; and

(c) That a comprehensive record and tabulation of rate schedules of all member companies be compiled and maintained in the secretary's office, which later might be distributed to member companies in the form of a rate book.

Engineering Committee.—Recommendations of the engineering committee which appeal most strongly to me are:

(a) The maintenance of a committee to co-operate with the engineers of the state commissions in working out needed revisions in existing rules and regulations and state laws affecting electric operation and construction.

(b) A continuance of systematic investigation of suspension insulators;

(c) Active co-operation with the National Association and manufacturers in the standardization of distribution transformers.

Accounting Committee.—Due to the requirements of standard systems of accounting, as prescribed by the several regulating bodies in our territory, the work of this committee has been confined to reporting conditions as they exist. A continuing committee to co-operate with the National Association in an endeavor to bring about a single unified system of accounting which might be adopted by all states in the Union, would be advisable.

Public Policy Committee.—The personnel of this committee is of such high character as to insure the correct treatment of questions of public policy. The committee's report, when presented, will be found to contain some practical and helpful suggestions concerning the intercourse between member companies, their employes, customers and the general public.

Capital Requirements

Capital investments of Class A member companies of Pacific Coast section now exceed $500,000,000, as part of the $3,000,000,000 invested by all Class A member companies of the National Electric Light Association.

With the ever increasing demands for electric service, utility companies must exert every energy to secure the capital necessary to meet the constant growth and this phase of the business is only now beginning to be appreciated even by those who have been directly confronted with this grave question. The great disparity in the requirements of capital between utilities and commercial undertakings is so marked as to at first thought challenge comparison. Speaking generally, a mercantile establishment can turn its capital four to eight times a year while a utility company requires four to five years to turn its capital once. It is thus apparent that utilities must be allowed a sufficient margin between earnings and expenses to pay a fair return on the money necessary to do business and not only must the return be sufficient to attract capital but every possible precaution and safeguard must be provided to assure the investor of the safety of his investment. This important phase of our business resolves itself into two factors, first, a fair rate of return on investment, and second, protection of investments already made. Furthermore, a utility which, through wise, skillful and diligent management, has reached a point of such efficiency that it is enabled to improve its service to its consumers, to operate at a lower cost, and to more advantageously finance its requirements, should not be crowded into a position where it will be stripped of all the benefits of its performance, but rather should receive a recognition which would tend to put a premium upon careful, economical and efficient operation. The regulating bodies must eventually recognize that the utility which is most successful is the one which can best serve the public.

Municipal Ownership

With the modern doctrine of concentration of production and unified system of distribution serving large areas with diversified demands, the solution of the much mooted question of municipal ownership will be worked out solely along sane and logical lines. Certainly, the solution is not through continued strife, with destructive competition or other equally unfortunate consequences. Harmony and concert of thought and action between utilities and municipalities are both necessary and advantageous. Many municipalities are served by companies giving good service at reasonable rates and performing their whole duty to the public at a high standard of efficiency as parts of links of systems operating throughout large territories surrounding the municipalities. It is quite obvious and beyond contradiction that the service furnished by these companies, keeping in mind that such service is adequate and reasonable, is of greater economic benefit than could possibly be given by plants which the municipalities might build to serve only their own local needs in competition with private systems.

Water Power Development

In California alone, the maximum potential water power development is estimated at 8,500,000 horsepower, of which at the present time a total of only about 750,000 horsepower has been developed. Ninety-four per cent of the potential water power development is located at sites where federal permits are required. In the Western states, water power development has been extensive wherever existing laws and want of laws have not stepped in to block the way, but in the past few years extensive steam turbine plants have been built instead of water power. The industry is in dire need of federal laws authorizing water power permits, suitable and adequate as a basis for large investment, to encourage development.

Public utilities are natural monopolies in the regions served and are recognized and regulated as such. Experience has taught that the usual result of competitive service is duplicated capital, upon which the public must inevitably, directly or indirectly, pay a return. The cry of "monopoly," or "tendency toward monopoly" in the development of water powers, however, is unfounded. None exists and none is threatened. If the entire development in the United States were in the ownership of a single corporation it would not constitute a monopoly of the available water power. Organization into large groups creates diversified investment and the ability to procure capital at minimum rates for extensive development. An important element of the cost of public utility service is the cost of money; nd such cost, whatever it may be, must be considered by regulating commissions in fixing rates.

Cost vs. Rates

Cost of materials, supplies and commodities of all sorts have jumped amazingly in the past two or three years, but a review over a longer period reveals the fact that there has been a constantly increasing level of prices, aside from the abnormal advancement in the immediate past. In the last sixteen years, the average price of stable commodities has so increased that the purchasing power of a dollar has decreased almost fifty per cent. While these figures apply specifically to articles of food, they serve as a fair criterion of the condition existing in all commodities. The costs of raw materials of every description have shown a corresponding increase. Yet in the face of this, the rates for electric service have been steadily falling. The decrease in rates has been in even greater ratio than the increase in costs of other commodities and certainly development in the art of generating and distributing electricity has not alone brought about this condition. Indeed, the question may well be asked as to how it has been accomplished. The answer is that organization, efficiency and business development, creating greater use from present investment, are after all the most potential factors.

We are now confronted with an enormous increase in the cost of fuel oil which affects all our member companies and is particularly serious to our smaller companies. The larger hydroelectric systems will, of course, have some advantage in additional business which will gravitate to their lines by reason of this increase, the higher cost of fuel hurting the small private plant to a greater degree than the large generating station.

In conclusion, I wish to thank the officers and committees for the energetic and untiring efforts they have put forth during the strenuous weeks of getting the section started on a solid foundation. All credit is due them for their loyal co-operation and I fully realize that this is an entirely inadequate expression of appreciation.

The future of the section depends upon the individual and enthusiastic support of all its members. Our interests are mutual and while some details of operation may differ among companies, the underlying principles are the same. By holding to this basic fact, our future is assured and I have every reason to believe that the Pacific Coast Section will be among the foremost in electrical development and progress.

HIGH LIGHTS OF THE CONVENTION

The first annual convention of the Pacific Coast Section of the National Electric Light Association has passed into history as the most important event that has occurred in the electrical industry of the West. Numerically the registration of four hundred and eighty-six represents the largest gathering of Western electrical men ever convened. It was a convention of all the electrical interests of the Pacific Coast and not merely the central stations. Executives, engineers, commercial men, accountants, manufacturers, jobbers and contractor-dealers were all well represented.

The convention was opened by a commercial session and closed by an engineering session, both sections being so crowded for time in the conduct of their discussion that parallel sessions became necessary, though not originally contemplated.

The outstanding feature of the opening session was President Ballard's address, printed in full in these columns, and John A. Britton's reply to the address of Mayor Oscar Ford of Riverside. Mr. Britton's address will be published as a part of the complete stenographic record of the convention which will be printed in its entirety in these columns as soon as available. The report of the secretary and of the membership committee showed close to 1500 members enrolled in the Section. The treasurer's report assured the financial stability of the organization during the first year of its existence.

Commercial Sessions

Stanley V. Walton, chairman of the commercial committee, presided over the three commercial meetings in characteristically able manner. The discussions were spirited and will undoubtedly lead to many improvements in existing conditions. To summarize the discussion at this time would but anticipate and feebly bring out the points made by the speakers whose remarks will be printed in full in these columns subsequently.

The salient recommendations in the committee's report were adopted by the meeting as a whole in the form of three resolutions:

1. That a plan be adopted enabling the smaller operating companies to secure assistance in the matter of obtaining salesmen and other trained help through the secretary's office of the Pacific Coast Section.

2. That the member companies of the Pacific Coast Section lend active co-operation and support to the California Association of Electrical Contractors and Dealers and that a proposed plan be formulated by the commercial committee.

3. That member companies be asked to send to the secretary's office enough copies of effective rate schedules, rules and regulations to provide each member company with a complete set, and that new rate schedules, as issued from time to time, be sent to the secretary's office in sufficient quantities to enable him to keep each member's book up to date.

In addition to the Public Policy Committee's resolution tendering the service of the member companies to the United States Government in the present crisis the following resolution was presented and unanimously adopted:

Whereas, the Supreme Court of the United States has, in a recent decision, laid down certain rules governing the occupancy of public lands for water power purposes; and

Whereas, Congress will be called upon, during this session, to provide legislation carrying into effect the principles enunciated in said decision; and

Whereas, the States of the Union, represented in this convention are particularly interested in legislation which will advance, and not retard, further development of water power in said states; for the purposes of conserving natural resources.

Now, therefore, be it resolved that Congress, through the Representatives of the several states, be memorialized to work for such legislation as will permit the occupancy of public lands for water power development, under substantially the following conditions:

That permit be granted by the departments involved should not be of a revocable nature, but should be for a definite period of time—not less than fifty years—and shall not be forfeited, except by appropriate proceedings in a court of competent jurisdiction, whenever the permittee shall fail to comply with the provisions of any Act of Congress in relation to the matter; and that if the government elect to take over the property, at the end of the term of years leased, it shall pay to the permittee a just compensation therefor; that the charges or rentals for all lands used shall be determined by the average horsepower sold or used by the permittee for any purpose other than the operation of the plant.

Committee on Resolutions

The report of the resolutions committee, J. G. Scrugham, A. E. Wishon and W. P. Southard follows:

We wish to place on record as the first resolution, one coming from the convention as a whole and expressing the sentiments of each individual member, a resolution acknowledging our full appreciation of the work done, and the unselfish co-operation of the Journal of Electricity and of its staff. To the Journal and its organization this convention is indeed indebted:

Whereas, the Journal of Electricity has freely published in its columns all of the papers and reports presented at the Riverside Convention of the Pacific Coast Section of the National Electric Light Association, and has also published a Daily Service Issue during the convention,

Be It Resolved, that this association hereby expresses its hearty thanks to the Journal and places on record its appreciation alike of the generosity and efficiency with which this service has been rendered.

To the Southern Sierras Power Company and its entire organization, who have done so much to make this convention a success, we express the thanks of the body:

Therefore, Be It Resolved, that this body extends its thanks for the untiring effort and splendid entertainment of this company. And, further, we thank them for that which we have heard of and anticipate for tomorrow.

Without reflection on other convention locations, or fully admitting the climatic claims of our Southern California brethren, your committee wishes to present the following resolution:

Whereas, the management and staff of the Glenwood Mission Inn have accorded most pleasing hospitality to members of this convention, we hereby tender our thanks for the excellent service rendered, and express our appreciation of the efficient manner in which the large convention attendance has been handled.

Whereas, our sister section, the Northwestern Electric Light & Power Association has so graciously provided official representation in the person of Mr. O. B. Coldwell,

And Whereas, Mr. Coldwell has been a live inspiration in the conduct of all our discussions.

Be It Resolved, That the Association expresses its deep appreciation of the Northwestern Association's co-operation, and its debt of gratitude personally to our genial friend, Mr. Coldwell.

In view of the untiring efforts of the officers and the convention committee in making such a tremendous success of this, our first, convention:

Be It Resolved, That the hearty thanks of the Section be extended to the retiring officers and to the convention committee, by a rising vote of all present.

New Officers

The officers elected for the ensuing year are: President, H. F. Jackson, Sierra & San Francisco Power Company, San Francisco; Vice-Presidents, Samuel Kahn, Western States Gas & Electric Company, Stockton, and E. R. Davis, Pacific Light & Power Corporation, Los Angeles; Secretary, A. H. Halloran, Journal of Electricity, San Francisco, and Treasurer, A. N. Kemp, Pacific Light & Power Corporation, Los Angeles.

The executive committee consists of R. H. Ballard, Southern California Edison Company, Los Angeles; Henry Bostwick, Pacific Gas & Electric Company, San Francisco; W. W. Briggs, Great Western Power Company, San Francisco; Wm. Baurhyte, Los Angeles; George A. Campbell, Truckee River General Electric Company, Reno, Nevada; D. E. Harris, Pacific States Electric Company, San Francisco; H. C. Reid, Pacific Fire Extinguisher Company, San Francisco; W. P. Southard, Albuquerque Gas, Electric Light & Power Company, Albuquerque, New Mexico; K. E. Van Kuran, Westinghouse Electric & Manufacturing Company, Los Angeles; F. S. Viele, Prescott Gas & Electric Company, Prescott, Arizona; A. Emory Wishon, San Joaquin Light & Power Corporation, Fresno, Cal.; A. B. West, Southern Sierras Power Company, Riverside, Cal.

THE ENGINEERING SESSIONS

The sessions devoted to the papers prepared by the engineering committee proved unusually interesting and instructive. Detailed reports will appear in later issues of the Journal. In brief this discussion may be summarized as follows:

Friday Morning

Mr. Lisberger read a report on transformer standardization which dealt with proposed standards of type, size, voltage, ratios, and so forth. The report indicated that definite standards have been formulated for single phase transformers of the voltage ordinarily employed in distribution, and that further work was contemplated covering three-phase transformers and those of the higher voltage, substation type.

Mr. L. R. Brown indicated the reduction of cost of manufacture which would follow such standardization. He stated that a number of power companies throughout the country had been approached on this matter and all had given their approval of the new standards.

Mr. L'Hommedieu pointed that a further economy would inure to the manufacturer as a result of susch standardization and which would undoubtedly be reflected in the price to the consumer, by reason of the possible reduction in the local stocks and that another result would be quicker service in supplying transformers.

Mr. Downing opposed too refined standardization of power house and substation transformers, stating that the varying

requirements of this service necessitated special designs in each case.

Mr. Jackson urged that greater attention be given to the standardization of design and voltage of distribution systems and pointed out the present tendency on the part of certain engineers to diverge more widely in this respect.

In connection with a proposed general order of the Railroad Commission covering safety of pole line construction, Mr. Bridge indicated the probable scope of the rule, stating that the commission intended to consolidate the several orders and statutes dealing with this subject and to reconcile the various conflicting provisions therein. He stated further that the commission wished to collaborate informally with representatives of the various overhead line interests in formulating this order and appreciated the spirit of co-operation which had characterized the work to date.

In discussing this matter Mr. Geibel advocated uniform construction in crossings of wire lines over railroads.

Mr. Jackson stated his opinion that no better standard of construction should be required in crossing over railroads than in crossings over main highways. He contended that the hazard to the traveling public was as great in the case of lines constructed along highways as those crossing over them, and proposed a uniform standard of construction to be employed throughout the line and the avoidance of special construction at crossings.

In reply to the last mentioned remarks, Mr. Babcock stated that special precautions were necessary at crossings of wire lines over railroads for the protection of the railway signal system, the continued operation of which was essential to the safety and service of the railroads.

In connection with the engineering committee's report on deterioration of insulators, Professor Sorenson described a portable oscillator, designed by himself and used with considerable success on the high tension lines of Pacific Light & Power Corporation in detecting faulty insulators which the merger failed to eliminate.

In discussing Mr. Jollyman's paper on high head turbines, Mr. Koontz stated that the experience of his company indicated the fallacy of the general supposition, that turbines of this type were subject to extreme wear.

Mr. Poole reported a case of unsatisfactory operation of turbines at an installation in one of their plants on Bishop Creek. In this case the erosive effect of sand and dirt, due to cloudbursts, so reduced the efficiency of the wheel as to render its continued operation prohibitive.

Such water conditions are, of course, unusual.

Consideration was next given to Mr. Klauber's report on dimensional standardization of the hardware for clevis cap suspension insulators.

On motion duly put and carried the local section of the N.E.L.A. recommended the adoption of a five-eighths inch bolt instead of a one-half inch bolt as proposed by the manufacturers' committee.

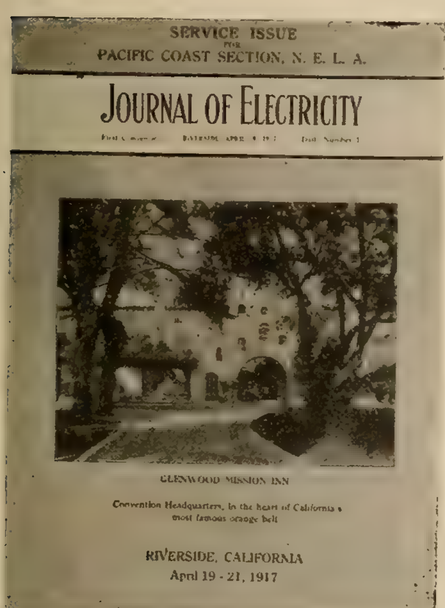
In discussing the subject of inductive interference and the work of the joint committee Mr. Warren indicated the inherent complexity of the subject, stating that the joint committee with limited time and resources had been able to do only the pioneer work of investigation. He hoped that means would be provided for the continuance of this work.

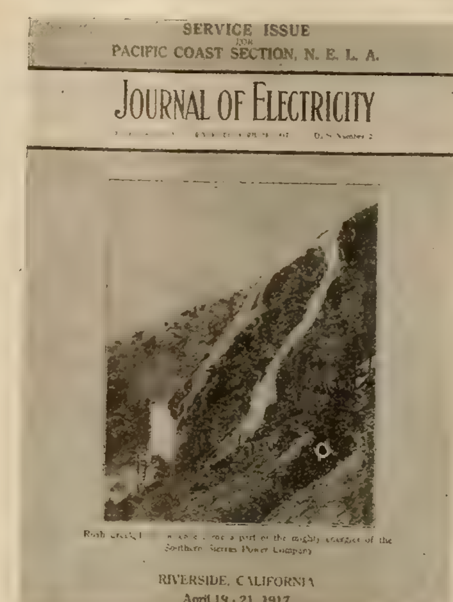
Mr. Bridge spoke of certain phases of the problem which the joint committee hoped to cover, based on information obtained since its first report to the Railroad Commission.

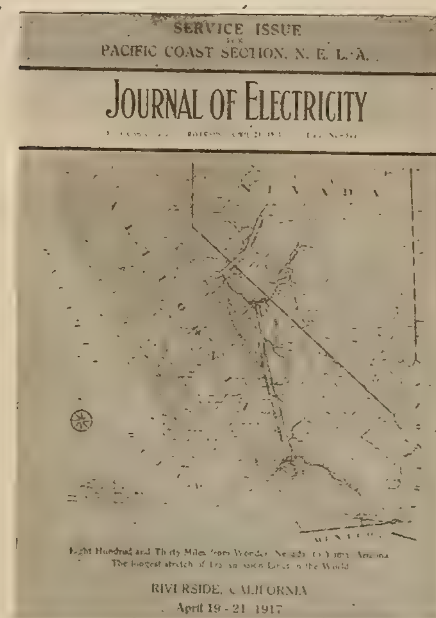
(Concluded on page 362)

THE SERVICE ISSUES OF THE JOURNAL OF ELECTRICITY

The Service Issues of the Journal of Electricity were published for the recent convention of the Pacific Coast Section of the National Electric Association by courtesy of the Technical Publishing Company, publishers of the Journal of Electricity. Their purpose was to report briefly the proceedings, official notices and incidents of the convention. Three issues were distributed gratis, one each on the mornings of Thursday, Friday and Saturday of convention week. The interest taken in their appearance was widespread throughout the convention attendance. Their sizes were in the nature of "baby journals," seven by five inches, miniature in type, but in every other respect similar to the usual appearance of the Journal of Electricity. The issues proved so effective as to call forth a resolution of thanks from the convention hosts. The three pictures shown indicate the outward attractive appearance of these little "baby journals" which were so affectionately received on all sides.







Panoramic View of the Convention Members and Guests at the First

Shadow of Unseen Spirit Rubidoux Hill

INSPIRATION must have literally been drawn from the very atmosphere, so successful proved the convention at Riverside. Perhaps the shadow of the Indian spirit, shown herewith which may be observed so mysteriously on any afternoon upon the crest of Rubidoux Hill that overlooks the city of Riverside, had something to do with it. At any rate the convention proved a great success from every viewpoint.

The banquet on Friday evening at the Glenwood was a unique and enjoyable affair. Good feeling and comradery existed to a high degree. The tables were a work of art in their setting with great transmission lines threading their way longitudinally and graced by banquetters on either side. Each guest was provided with a paper hat of "Uncle Sam" design and with the exquisite scenery of Spanish background on all sides the setting was truly enchanting.

In addition to a number of instructive and entertaining speeches the evening's program was enlivened into vociferous applause by the rendition of "The Song of the Lamp Socket" by a quartet from the Southern California Edison Company.

Saturday was devoted to sight-seeing. Sixty powerful automobiles conveyed the guests up to Pinecrest where luncheon was served a "mile high" above the sea which could, by the way, be dimly outlined upon the horizon to the West.

Too much credit can not be given to A. B. West of the Southern Sierras Power Company for his thoughtfulness and generosity as host of the convention and to R. H. Ballard of the Southern California Edison Company for his executive wisdom in predetermining all the little affairs incident to a convention and thus expedite the transaction of business and usefulness of a gathering of this nature.

THE SONG OF THE LAMP SOCKET

Music: "When I was a Lad," (Pinafore).

(By Charles Heston Peirson, with apologies to Pinafore).

(By the Percolator)

When I was a Kid I didn't aspire
To be such a sport as to boil by wire;
I stood on the stove 'til I got hot
And they called me the Darned old coffee pot
And I boiled and I boiled on stove and grate
'Til Hotpoint taught me to percolate.

Chorus:

He boiled and boiled on stove and grate—
'Til Hotpoint taught him to percolate.

(By the Toaster)

In days that are gone I used to toast
And I toasted so bad that I cannot boast
I toasted by wood and coal and gas
But I scorched and I burned and smoked, Alas!
I reeked with ashes and I caked with grit
'Til they taught me to toast from a lamp sock-et.

Chorus:

He reeked with ashes and caked with grit
'Til they taught him to toast from a lamp sock-et.

THE LADIES' PRIZES AND THEIR WINNERS

Prizes for the ladies proved attractive features of entertainment both aboard the Golden Gate Special and at the convention. Mrs. H. F. Jackson, Mrs. W. S. Berry and Mrs. E. B. Strong proved themselves to be gracious and efficient committee workers for entertainment of the lady guests.

On board the Golden Gate Special the prize winners were: Mrs. Dave Harris, Mrs. T. W. Simpson, Mrs. Geo. A. Campbell, Miss Gladys Strong and Mrs. Louis Levy.

At the ladies' card party at the Glenwood Inn prizes were won by the following:

Table No. 1—Mrs. W. S. Berry. Table No. 2—Miss Gladys Strong. Table No. 3—Mrs. A. C. Reynolds. Table No. 4—Mrs. R. H. Sterling. Table No. 5—Mrs. F. F. Maessen.

The following were the beautiful prizes and their donors:

Flashlight, presented by Electric Railway Manufacturers' Supply Co.; electric curling iron, presented

f the Pacific Coast Section of N. E. L. A., Riverside, Cal., April 19-21, 1917

(By the Chafing Dish)

Of things that kill I have cooked my share
Such as hot Welsh Rarebit that brought despair;
I'm built for lobster and oyster stew
Or, the water for a toddy I will boil for you;
You push the button; I'll do your wish
For I'm the 'elec-tric Chafing Dish.

Chorus:

We push the button; he does our wish
For he's the 'elec-tric Chafing Dish.

(By the Iron)

Once on a time they called me sad
But now, By Jove, I am always glad;
I scorched and I burnt for the ladies fair
Those unseen garments that are called "white wear"
But I've quit my scorching as all may see
For the heat in my "tummy" is juice in me.

Chorus:

He quit his scorching as all may see
For the heat in his "tummy" is juice in "he."

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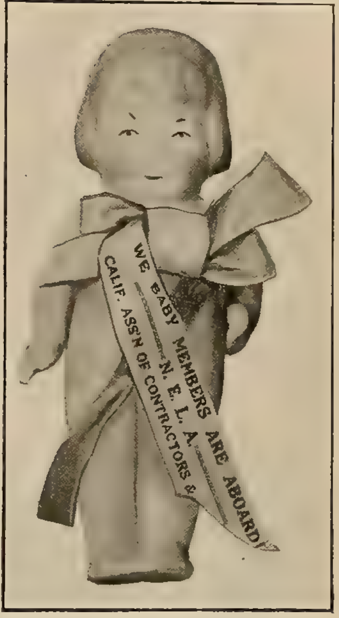
by Pacific States Electric Company; electric iron, presented by Western Electric Company; electric iron, presented by Holabird-Reynolds Company; heating pad, presented by H. W. Johns-Manville Company; five Benjamin plugs, presented by Western Electric Manufacturing Company; hand electric lantern, presented by American Eveready Company; curling iron heater, presented by Electric Appliance Company.

Attractive boxes of candy were distributed to all the ladies.

The Victrola from Sherman & Clay and the records loaned by many members of the party aboard the special added much to the merriment of the party. The equipment and service of the Southern Pacific Company was excellent and much throughtfulness was displayed by Chas. S. Fee in wiring ahead to all division superintendents to show every courtesy to the guests of the special and provide every comfort and attention. While the return trip was lengthened by many unfortunate delays, the added period of time made possible additional pleasures and additional enjoyment that otherwise would have been impossible.

THE ELECTRICAL CONTRACTORS' STUNT

One of the most unique and catching stunts that were pulled off upon the Golden Gate special from San Francisco while on its journey to Riverside was the "baby doll" gift from the electrical contractors symbolic of the fact that the electrical contractors were the baby members of the Pacific Coast Section of N.E.L.A. Each member of the party—man, woman, and child—was presented with a baby doll, bedecked with neatly emblazoned ribbons, showing that the doll was from the baby members of the Section. Needless to say all members of the party prize the gift highly. Each gift is now in the enviable possession of the little tots at each of the respective homes.



Doll Baby Gift of the Electrical Contractors

It was a source of gratification to all to witness the splendid attendance and participation of the electrical contractors in the convention activities as was also the large representation of jobbers and manufacturers' representatives that was noted at this gathering.

The one outstanding feature of the convention was this evident spirit on all sides looking toward a closer understanding in the future between contractor, central station, jobber and manufacturer. And this splendid spirit of helpfulness and co-operation displayed at each section meeting and social gathering spells but one word for the future, and that word is "success."

Now that this convention has been so successfully consummated, much talk is going the rounds as to how members of the Pacific Coast Section of the N. E. L. A. may assist the Northwest Electric Light & Power Association in making the September convention at Spokane exceed even the wonderful success of former conventions of that association.

FUEL OIL AND STEAM ENGINEERING

(The mechanical horsepower, the kilowatt, the boiler horsepower and the myriawatt units, bearing irrational factors of relationship the one with the other, cause endless confusion in fuel oil and steam engineering practice. Here is a discussion that first traces the historical development of these important power units and then clinches the discussion by establishing quick and ready means of transferring the rating of boilers in one of these units to that of another. An instance of how the Builder's Rating is computed by taking the physical measurements of the boiler is also set forth in detail.—The Editor.)

HOW TO COMPUTE BOILER HORSEPOWER

BY ROBERT SIBLEY

How James Watt Would Have Standardized a Mechanical Horsepower at the Panama-Pacific Exposition

THAT energy is never created or destroyed is a fundamental postulate of modern engineering practice. All of our machines and driving mechanisms are, then, simply devices by means of which we may convert one form of energy into another form to suit our convenience or meet the demands of industrial activity. Thus an electric generator does not create energy but is merely a device whereby energy existing in the waterfall or in the steam turbine may be converted into electrical energy. Neither does the energy exist inherently in the waterfall, but due to the emission of heat from the sun, this water has first been drawn from the ocean into the clouds to be later deposited on the lofty mountain peaks. Due to this superior position it is enabled to develop water power energy and thus transfer the energy of the sun's rays into more useful form to ease man's burdens. And so with the steam boiler, we have fundamentally a mechanism by which energy latent in fuel oil or other combustible is first given out as heat energy of combustion to be immediately converted into latent heat energy of steam.

The Meaning of the Word "Rating."—The rapidity with which this conversion of one form of energy into another form may be accomplished is known as the rating of the mechanism involved. Thus a small boy may by means of a block and tackle hoist a huge weight to the top of a modern sky-scraper and at a later observation one may see a team of horses straining to their utmost to accomplish the same task. By close inspection, however, it will be found that the small boy has by means of intervening pulleys been able to take from thirty to forty times longer to accomplish what the horses did in a comparatively short time. Hence power, the basis of comparative effort, is the time rate of doing work.

The Development of the Word "Horsepower."—After his invention of the steam engine, James Watt soon found that he must devise some unit or measuring stick, as it were, with which to measure the power of his mechanism. As he was a pioneer in the art, he had to cast about for some convenient unit to adopt. What more natural unit should he consider than that of the draft horse? After watching a horse drawing up large cakes of ice into an ice house by the use of a snatch block, it occurred to him that when the horse pulled up a fairly good load he must be doing a certain amount of work. After making several experiments he found that by adding more sheaves to the blocks the horse could raise a greater load but it took more time to do it. He found that the average dray horse was able to raise a load of 550 lbs. at the rate of 60 ft. per minute, or to do 33,000 ft. lbs. of work per minute. This unit Watt called a horsepower and applied it to the measurement of the power of his steam engines.

The Boiler Horsepower.—In the early days of the steam engine the principle of the conservation of energy had not been firmly established. Indeed that heat was a form of energy at all was a debated question for many years after the steam engine became of vast practical importance.

Hence, since the energy latent in steam was not then known to be the underlying reason for the power driving action of the steam engine, the first rating of the boiler was made on the basis of power development in the engine which received its supply of steam from the boiler in question. Thus a boiler that could supply steam to operate a steam engine developing 50 indicated h.p. was said to be a 50 h.p. boiler. Later it became evident, due to the rapidly increasing efficiencies of the steam engine that such a rating was wholly variable. It was found, however, that under ordinary working conditions a boiler which could evaporate 30 lb. of steam per hr. at 70 lb. pressure and taking feed water at 100° F. could usually operate a 1 h.p. engine, consequently this mode of boiler rating became popular.

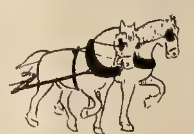
In 1884, the American Society of Mechanical Engineers adopted the following definition for the boiler h.p.: That a boiler evaporating 34.5 lb. of water at 212° F. into steam at 212° F. per hr. should be known as a 1 h.p. boiler.

The Conversion of Boiler Horsepower to Mechanical Horsepower Units.—In later years the principle of the conservation of energy finally became well established and when engineers began to compute the actual energy represented in a mechanical horsepower

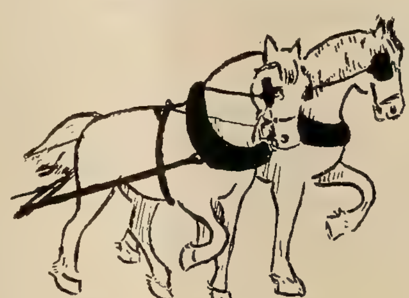
as originally adopted by James Watt and then compare this to the energy represented in the steam generated by what was known as a one horsepower boiler, it was found that the boiler horsepower represented the conversion in unit time of over thirteen times the energy represented in the mechanical horsepower unit acting over the same unit of time.

It is instructive to follow this computation as it will familiarize the reader with these two distinct units. Let us then proceed to an analysis. The mechanical horsepower unit is defined as a performance of work or conversion of energy at the rate of 33,000 ft. lb. per minute. Since 1 B.t.u. of energy has been found to have its equivalent in 777.5 ft. lbs. of mechanical work, it is seen that 33,000 ft. lb. of work per minute, or 1,980,000 ft. lb. of work per hr. may be represented by 2547 B.t.u. per hr. From the definition of the boiler horsepower above mentioned, as that adopted by the American Society of Mechanical Engineers, it is seen that since it requires 970.4 B.t.u. to evaporate 1 lb. of water at 212° F. into steam at 212° F., one boiler horsepower represents 34.5×970.4 B.t.u. per hr. or 33,479 B.t.u. of heat energy per hr. Hence, when we compare the boiler horsepower with the ordinary horsepower it is seen that the boiler horsepower represents a unit which is 13.14 times larger than the ordinary horsepower.

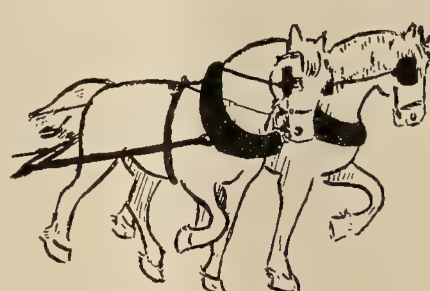
The Mechanical Horsepower
(The Unit of Power in Modern Steam Engineering)



The Kilowatt
(The Unit of Power in Electrical Engineering, which is 1.34 times the mechanical horsepower)



The Boiler Horsepower
(The Unit of Power in Boiler Practice, which is 13.14 times the mechanical horsepower)



The Myriawatt
(The Unit for Boiler Rating Proposed by Certain National Engineering Societies, which is 13.4 times the mechanical horsepower)

The Myriawatt as a Basis of Boiler Performance.—In recent years, due to the tremendous growth in the electrical industry, engineers have recognized the inconsistencies of the boiler horsepower unit and an effort has been made by the national engineer societies to make a more rational standard of rating. As a consequence, the American institute of Electrical Engineers has proposed that the Myriawatt be adopted as a standard of boiler rating instead of the Bl. h.p. A Myriawatt is the power equivalent of 10,000 watts or 10 kw. which converted into heat units become 34,150 B.t.u. per hr. Although it is still to be remembered that the Myriawatt does not yet make output and input of electrical units expressible in like quantities, since output is usually expressed in kilowatts, still the factor of 10 furnishes a basis readily convertible and makes possible a change in units without materially upsetting the old boiler h.p. range of capacity.

If, then, a boiler evaporates M pounds of steam per hour and the total heat of each pound of steam so evaporated be H and the heat of liquid represented in the feed water be h_f, then the rating of a boiler in Myriawatts is evidently

$$\text{Myriawatts} = \frac{M\,(H - h_f)}{34{,}150} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Relationship of Boiler Horsepower and Myriawatts.—Similarly, since one boiler horsepower is equivalent to heat absorption of 33,479 B.t.u. per hour, and a myriawatt to 34,150 B.t.u. per hour, then we may convert a rating in Myriawatts to a rating in boiler horsepower or vice versa by the relationship:

$$\frac{\text{Rating in boiler horsepower}}{\text{Rating in Myriawatts}} = \frac{34{,}150}{33{,}479} \quad (2)$$

The Builder's Rating.—In the commercial evolution of the steam boiler there has grown up a method of rating boilers by "rule of thumb" process. It is evident that the area of the steam generating surface of the boiler actually exposed to the heated gases of the furnace has something to do with the capacity of the boiler. For different designs of boilers, however, the particular factor to be applied varies widely. It has become of common acceptance, however, that 10 sq. ft. of boiler surface exposed to the furnace heat shall be considered on this rule of thumb comparison as equivalent to one boiler horsepower. Hence to compute the builder's rating of a boiler we must compute the area in square feet of the surface exposed to the furnace. By dividing this area A by ten we arrive at the Builder's Rating:

$$\therefore \text{Bl. h.p. (Builder's rating)} = \frac{A}{10} \quad \ldots\ldots\ldots (3)$$

As a detailed illustration, let us take the case of a Parker boiler installed at the Fruitvale Power Station of the Southern Pacific Company in Oakland, California.

This boiler is made up of three banks of tubes with two drums above, half exposed. In detail we compute as follows:

Tubes 4 in. diameter, circumference = 12.566 in. = 1.0472 ft.
Tubes 18 ft. long = 18×1.0472 = 18.85 sq. ft. of H. S.
Tubes 20 ft. long = 20×1.0472 = 20.94 sq. ft. of H. S.
Heating Surface, Bottom Row of Tubes:

20 tubes with 18 ft. of — Heating area
length exposed to gases $= 18.85 \times 20 =$ 377.00 sq. ft.

Heating Surface, First Pass:
100 tubes with 20 ft. of
length exposed to gases $= 20.94 \times 100 =$ 2094.00 sq. ft.

Heating Surface, Second Pass:
80 tubes with 20 ft. of
length exposed to gases $= 20.94 \times 80 =$ 1675.20 sq. ft.

Heating Surface, Third Pass:
80 tubes with 20 ft. of
length exposed to gases $= 20.94 \times 80 =$ 1675.20 sq. ft.

Drums:
2 drums 54 in. diameter, 18½ ft. of length
exposed to gases: circumference = 14.1 ft.;
½ of circumference 7 ft. $= 7 \times 18.5 \times 2 =$ 259.00 sq. ft.
——— sq. ft.
Total .... 6080.40 sq. ft.

Hence, we have that the builder's rating of this boiler should be

$$\text{Bl. h.p. (Builder's rating)} = \frac{6{,}080.4}{10} = 608.04.$$

To Compute Actual Boiler Rating.—Since it is seen from the fundamental definition of the boiler horsepower that the standard reference boiler generates its steam from water at 212° F. into steam at 212° F., we must next develop a factor by which we can reduce ordinary boiler performances of high temperatures and pressures to this fictitious standard before we can proceed further. The next chapter will be devoted to this consideration.

(Continued from page 357)

Afternoon Session.

In discussing Mr. MacDonald's paper, Mr. Warren emphasized the need of a rigid specification. He stated that the Bell companies are, in general, desirous of effecting joint use in urban distribution.

Mr. Northmore said that conditions in Los Angeles with three power companies, two railway companies and two telephone companies rendered joint use mandatory. As a result a joint pole committee was created and a form of contract drawn up which was still in use. He stated that the contract should be legally exact but the specification sufficiently flexible to meet changing conditions. Through co-operation between the various interests excellent results had been obtained, this attitude being essential to any success.

Mr. Cuningham stated that he does not favor a rental basis for joint use because of the difficulty and expense of computing the rents annually.

In closing the discussion Mr. MacDonald said that the original record system adopted by the Los Angeles Committee soon became cumbersome on account of the mass of data required to be furnished by the committee. This difficulty had been largely overcome by a changed system of recording the member companies now furnishing the necessary data.

The papers of Mr. Cuningham and others on line protective apparatus were next discussed.

Mr. Downing traced the development of switches and other protective equipment. He related the troubles of other protective equipment. He related the troubles of with non-interconnected air-brake switches, followed by oil switches which were troublesome owing to the lack of suitable non-inflammable insulating materials. The present day oil switch employing non-inflammable materials exclusively he described as being very satisfactory in its operation.

Mr. J. Thompson followed with a general condemnation of fuses. He said that fuses were usually unsatisfactory in their operation but are still a necessary evil on account of the need for economy in the construction of unimportant lines. He summarized the theory of fuse protection as the destruction of the weakest link in a power line and localization of the resulting damage. An essential requirement is that the material destroyed should be as cheap as possible.

Mr. Barre stated that in his opinion the use of fuses would be extended in the immediate future as a result of pressure which he expected would be brought to bear on power companies by the Federal Government in its campaign to augment the nation's food supply. The extension of facilities would require the exercise of most rigid economy in the construction of rural distribution lines.

Mr. Klauber stated that in his experience trouble ascribed to fuses was often due to improper fusing, and that the use of standard sets of fuses have largely eliminated this trouble.

In introducing the subject of Mr. Morgan's paper Mr. Woodbridge stated that one important problem of stand-by steam plant operation, is the possible reduction in steam supply to a steam turbine operated as a synchronous condenser without overheating the turbine blades.

Mr. Quinn said that his company had operated a 2000 kilowatt Curtis turbine as a condenser without steam and with no apparent injury to the blade. The method used was to open the man-holes and admit air to the turbine.

Mr. W. J. Davis described two methods of operation without steam—both of which he said would ultimately result in deterioration of the blade metal through overheating. One consisted of admitting air to the turbine and the other maintenance of a vacuum. He believed that in either case the resulting internal temperature would be too high, although in some cases periodic replacement of the blading might be less costly than the fixed charges on a separate condenser.

Mr. Lincoln and Mr. Koontz reported cases of satisfactory operation without steam employing a vacuum.

Mr. Downing stated that it was the practice of his company to operate turbines as synchronous condensers supplying steam to the extent of 5/10 per cent of full load requirements. He believed they could not afford to use a method which might damage turbines which are required constantly for standby service.

Mr. Wood stated that his method of carrying some load on the plant and rotating the boilers made possible extremely rapid load assimilation in emergencies.

Mr. Russell advocated insulation of boiler walls as a means of reducing standby fuel requirements.

Mr. Morgan said his tests indicated a definite rate of steam supply corresponding to the minimum temperature of the turbine when operated as a condenser. He reported an interesting case of neutralizing electrolytic corrosion of condenser tubes by means of circulating current supplied from a low voltage generator.

Professor Scrugham stated that it was the intention of the N.E.L.A. to give employment in electrical industries to two thousand college students during the summer vacations, and requested that all who might have use for such men would communicate with the secretary of the local section. He invited the submission of proposed subjects for research.

The world's gold production in the last quarter of a century equals that of the preceding four hundred years, and the silver output since 1878 equals that of the preceding four hundred years. The gold money of the world has doubled in the last twenty years and the silver money of the world has decreased one-half in the same period.

SPARKS—Current Facts, Figures and Fancy

(The recovery of waste products has been the financial salvation of many an infant industry. Below is a jotting of how the Japanese are making use of millions of cast-away oil cans to be later used for the manufacture of toys. In every central station the disposition of junk to advantage often becomes difficult. This item and others appearing in the "sparks" below may perchance give you an idea for bettering service or originating new channels of business endeavor.—The Editor.)

One-third of the world wool supply is today used in uniforms of men of the warring countries. In England alone in the first seventeen months of the war sixty-eight million pounds were used for this purpose.

* * *

The Jovian Order of Mansfield, Ohio, held a rejuvenation in which there were 13 members, who attended with 13 friends. The dinner cost $13, there were 13 tables, and it was held on Friday, the 13th of April.

* * *

Five million empty five-gallon oil cans were recently shipped as junk to Japan. These will some day appear again in American markets as tin soldiers and other toys dear to the heart of young America. This is a striking instance of recovery of waste products; why can't we Americans think of some of these things?

* * *

The entire resources of the Southern Pacific Company and auxiliary companies with their forty-five thousand employees are today aligned with the United States Government for the mobilization of troops and supplies, acting in concert with the Federal authorities under an arrangement worked out by a committee of railroad executives.

* * *

John D. Rockefeller, Jr., in a recent address at Cornell University states that although in the past chief executives of important industrial corporations have been selected largely because of their capacity as organizers or financiers, the executive of the future will be chosen largely on his ability to deal successfully and amicably with labor.

* * *

Letters are being written to the governors and fire marshals of the different states, and to the mayors, fire chiefs, health officers and chambers of commerce in several hundred of the leading American cities, urging that the first week in May (which this year began upon April 30th), be designated and observed generally as a spring "Clean-up Week."

* * *

The Electrical Review of London recites the fact that strong resentment on the part of British firms in Australia is being aroused by the extraordinary preference given to foreign manufacturers when material for construction is wanted. The procedure is said to exhibit such a bias in favor of American manufacturers that all others are practically excluded from consideration. While ever-increasing commercial and engineering relations with our Pacific neighbors is exceedingly desirable still no true American would want this trade for an instant unless devoid of bias and winning its entrance on service and quality alone.

The twenty national forests in California comprise almost twenty million acres of land and contain nearly nine thousand miles of road. There are in addition ninty-five hundred miles of trail which make accessible the more remote regions.

* * *

Just as fine fibre flax as is grown any place in the world can be cultivated in the Puget Sound region. This is the conclusion reached by Dr. A. W. Thornton of Ferndale, Wash., after an investigation of several years covering the soil, climate and water of the western part of the state.

* * *

Reports submitted by fifty-three railroad companies, comprising all that operate oil-burning locomotives in the United States, show that the quantity of oil fuel so consumed last year was over forty-two million barrels, a gain of 15 per cent over the consumption in 1915.

* * *

The production of copper from the mines of the United States for 1916 was more than double that of ten years ago and more than four times that of 20 years ago. The profit resulting from the domestic production was far greater in 1916 than in any previous year. It is probably safe to say that it exceeded $300,000,000.

* * *

According to the government census figures, electric light is practically the only item which has shown a decrease in the cost of living. This is mainly on account of the improvements in the incandescent lamps, but the cost of the current itself has also been reduced as a result of the rapidly increasing use of electricity for other purposes in the home and in industries.

* * *

Advise reasonable and sane use of the electrical pump for irrigation. If you want to grow the heaviest possible crops of alfalfa, and get the largest money return from the water used, do not apply more than thirty to thirty-six inches of irrigation water a year. To apply more than thirty-six inches usually does not produce corresponding increase in yield. Most California alfalfa-growers over-irrigate.

* * *

Four solid train loads of beans from the Orient, valued at over a million dollars and constituting the largest movement of this commodity ever coming to the United States, have arrived in San Francisco to be trans-shipped by the Western Import Company to Eastern markets. Here is an opportunity for increasing the central station activity at home in electric pump operation for the future in bean growing.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

THIS country of ours is admittedly the most blessed in finances, natural resources, productiveness of soil and in the ingenuity of her citizens. The only conceivable argument that can be advanced against a possible victorious outcome of the task ahead is that sufficient preparation and detail in organization were lacking. Let us take no chances. From the most skilled engineer to the helpless babe each has a part to play. The blind poet, Milton, has long since voiced those immortal words: "They also serve who only stand and wait." As engineers, we stand in readiness to play the part that best we may fill. We wait, but only that the assignment may be the more sure and the task the more thoroughly accomplished. We do not in the ordinary run of things send a dentist to babbitt a bearing or a mechanical engineer to put in a new crown. The only safe and proper way to conduct the gigantic task ahead is to draft the entire working force of the nation and put each at the task for which he is best fitted.

GRATEFUL THANKS

For months the editorial and managerial staff of the Journal of Electricity have worked to give of their best to make the convention at Riverside an unprecedented success. To have come back from that wonderful gathering of men of the electrical industry with the inward realization that the Journal had been a factor—no matter how small—in bringing about the successful consummation of that convention, would in itself have fully repaid them for all their efforts. To receive the following beautiful expression from the convention calls forth our deepest and most grateful appreciation and stimulates us one and all for still better and more effective work ahead:

"We wish to place on record as the first resolution, one coming from the convention as a whole and expressing the sentiments of each individual member, a resolution acknowledging our full appreciation of the work done, and the unselfish co-operation of the Journal of Electricity and its staff. To the Journal and its organization this convention is indeed indebted:

"Whereas, the Journal of Electricity has freely published in its columns all of the papers and reports presented at the Riverside Convention of the Pacific Coast Section of the National Electric Light Association, and has also published a Daily Service Issue during the convention.

"Be It Resolved, that this association hereby expresses its hearty thanks to the Journal and places on record its appreciation alike of the generosity and efficiency with which this service has been rendered."

Hydroelectric Preparedness

The beautiful and inspiring words expressed at the Riverside Convention by those who direct the great hydroelectric investments of a half billion dollars in four of the commonwealths of the West are a source of gratification to all who have followed the trend of evolution in utility development in recent years. The spirit of fair play and the spirit of patriotism so pervaded these official utterances that those hearing them in the audience involuntarily came to the realization that the hour of national need will not find the industries and arteries of human activity choked and throttled but, like the battleship Oregon rounding Cape Horn in the days of the Spanish controversy, American industrial activity enters upon the scene with boilers at full pressure and a store house of energy equal to any emergency.

A Spirit of Co-operation

The fact that stands forth as pre-eminent among all the interesting features that developed at the Riverside convention is the remarkable spirit of co-operation that was observable on all sides. While certain leaders towered above the general mass of assembled men of the industry still it was obvious on all sides that the real success of the convention was due in an unusually large degree to the contributions of the many rather than the few. Such co-operation as that engendered at Riverside can not fail to augur much not only for the future good of the Pacific Coast Section but indeed the electrical industry itself throughout the entire nation must ultimately feel its rejuvenating influence.

A Forceful Instance of Utility Service

The safety and welfare of the nation in times of war, as well as in peace, demand the continuance of the operation of transportation and of industrial and agricultural pursuits. Since the hydroelectric companies of the West are large factors in the furnishing of energy for transportation, and of energy for light, heat, and power purposes, particularly in the supply to industrials and for irrigation, the unanimous tender of system and service to the government of the United States at the Riverside convention came as an eloquent and graceful expression of the high sense of loyalty, patriotism and unselfish service engendered in utility evolution of modern times.

The Northwest E. L. & P. Association

Now that such splendid geniality and comradery has come down from the north in the personage of O. B. Coldwell and now that friendly and diplomatic relations have so auspiciously been thus established between the Pacific Coast Section of N. E. L. A. and the Northwest Electric Light & Power Association, it behooves the entire membership of the Pacific Coast Section to do everything in its power to make the convention of the Northwest Electric Light & Power Association at Spokane in September the crowning gathering of its many successful meetings of former years.

Such a thing as a special train to the north from California has not been an unknown event in the past. The glowing recollections of the Golden Poppy Special to Seattle some years back are too well placed in memory for that.

If there is one thing we must avoid in the present national crisis, it is to fight against paralysis of effort. The annual convention of the National Electric Light Association at Atlantic City has been called off. Undoubtedly the arguments for and against such action were carefully weighed before this decision was arrived at, consequently we pass this by without comment.

Nevertheless, the enthusiastic gathering at Riverside has thoroughly demonstrated the fact that men, even in these troublous times, can gather together and bravely plan for the future, bereft of fear or forebodings.

Hence to the Northwest Electric Light & Power Association Convention at Spokane in September all eyes now expectantly turn.

Stabilizing the Hydroelectric Industry

Much has been said in the past with reference to permits and rights of way across the national domain. The time for talk has long since past—action is what is desired.

The hydroelectric fraternity throughout the West has demonstrated during the present national crisis that it is deserving the highest respect and merits the full confidence of the nation. Its system and service have been freely and loyally offered to the government. All that is now asked is that a reasonable stability be given to the enormous investment of capital now held in hydroelectric securities in the West which amount to nearly three-quarters of a billion dollars.

The recent supreme court decision known as the Utah case denies to hydroelectric companies fee title to rights-of-way over government land and restricts their use so that they become as mere leases or easements issued by the Department of the Interior or Agriculture.

To properly and equitably adjust this entire matter new legislation should be enacted at the earliest reasonable period possible so that such permits as may be granted should not be of a revocable nature, but should be for a definite period of time—not less than fifty years—and should not be forfeited, except by appropriate proceedings in a Court of Competent Jurisdiction, whenever the permittee shall fail to comply with the provisions of any Act of Congress in relation to the matter. Since practically all hydroelectric promotion is accomplished by the floating of long time bond issues, the period of not less than fifty years is absolutely necessary for stabilizing investments of this nature.

Then, too, there is the question of possible acquisition of the property by the government. If at the end of the fifty year period the government should elect to take over the property, it should pay to the permittee a just compensation which would take into account all of the properties affected by the lease.

In regard to the question of rentals, no one denies that a reasonable charge should be made based upon the average horsepower sold or used by the permittee for any other purpose than the operation of the plant.

PERSONALS

A. B. West, vice-president and general manager of the Southern Sierras Power Company, the recent host of the first annual convention of the Pacific Coast Section N.E.L.A., brought out the unanimous unofficial and official hearty commendation of the convention for his splendid entertainment and untiring efforts in which the beautiful and gracious talent of Mrs. West is linked in all words of praise heard from those attending this great gathering.

Paul M. Lincoln, electrical engineer of the Westinghouse Electric & Manufacturing Company is at San Francisco from Pittsburgh.

Frank E. Bonner, engineer in charge of maps and surveys for the Forestry Service, is a recent San Francisco visitor from Washington, D. C.

Geo. H. Battee has been made president and general manager of the Aylesworth Agencies Company, of which **H. G. Aylesworth** is vice-president.

H. E. Bittman has resigned as secretary of the Telephone & Electric Equipment Company to become secretary of the Aylesworth Agencies Company.

W. P. Southard, manager of the Albuquerque Gas, Electric Light & Power Company, was an active delegate to the Riverside convention from New Mexico.

Ira J. Francis is to be made manager of the San Francisco office of John A. Roebling's Sons Company. He will be succeeded as manager of the Los Angeles office by **James Colkitt.**

George B. Muldaur, field secretary of the National Electric Light Association, was the official representative at the Riverside convention for President Wagner of the national organization.

H. P. Andrae, secretary-treasurer, representing Julius Andrae & Sons Co. of Milwaukee, with Mrs. Andrae, is spending a month on the Pacific Coast on a pleasure trip, having spent the past week in Los Angeles.

C. W. Forbrich, western manager of the Electrical Review and Western Electrician since 1908, has resigned his position to enter the advertising field on his own account, a plan which he has had under consideration for some time.

H. L. Allen, manager of the Pacific Gas & Electric Company of Phoenix, Arizona; **C. S. Thompson,** manager of the Bisbee Improvement Company; and **G. T. Herrington,** manager of the Flagstaff Electric Light Company, were delegates to the Riverside convention from Arizona.

J. G. Scrugham of the Elko-Lamoille Power Company; **F. H. Mechling,** manager of the Nevada-California Power Company; **George A. Campbell,** manager of the Truckee River General Electric Company, and **H. A. Lemmon** of the same company, were delegates to the Riverside convention from the State of Nevada.

E. H. Rollins of the financial firm of Rollins & Co. of New York City; **Guy Tablot,** president of the Pacific Power & Light Company of Portland, and **Max Thelen,** president of the California Railroad Commission and president of the National Association of Railroad Commissions, were among the distinguished guests at the Riverside convention.

M. Yokoyama and **T. Komuro,** electrical and chemical engineers, respectively, of the Yokohama Electric Wire Works, Yokohama, Japan, have left for eastern points after spending two weeks in San Francisco and Los Angeles. They are studying central station and transmission methods in this country. While here they were the guests of **H. F. Hartzell,** Los Angeles manager of Baker-Joslyn Company.

C. O. Poole, electrical engineer for the Southern Sierras Power Company ably entertained the guests of the Riverside convention by means of a stereopticon lecture on Thursday evening of convention week, in which he depicted the interesting engineering features of his system. Mrs. Poole proved herself an able help mate by her assistance in entertainment of the lady guests throughout the convention.

T. E. Collins, formerly sales manager of the Pacific Electric Manufacturing Company, is now engaged in the business of manufacturers' agent, representing the J. H. Parker Porcelain Company of Parkersburg, West Virginia, the Adams Bagnall Electric Company of Cleveland, Ohio, and will also act as general sales agent for the Bowie Switch Company. Mr. Collins is a Jovian Congressman from this district and an active worker in all affairs electrical.

O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, has returned to Portland from a brief visit to California during which visit he was the official representative of the Northwest Electric Light & Power Association at the Riverside convention of the Pacific Coast Section of N.E.L.A. Mr. and Mrs. Coldwell won many friends in the southland and a host of new-made friends bemoan their early departure to the north.

W. L. McKinley of the Southern Sierras Power Company; **Joe Thompson** of the Pacific Electric Manufacturing Company; **R. E. Fisher** of the Pacific Gas & Electric Company; **L. S. Ready** of the California Railroad Commission; **W. R. Dunbar** of the Westinghouse Electric & Manufacturing Company, and **E. M. Cutting** of the Edison Storage Battery Company, are receiving congratulations on all sides for the splendid entertainment features they planned and executed on the Golden Gate Special.

Robert Eltringham, engineer for the California Industrial Accident Commission, was given an excellent opportunity to render first aid treatment to an accident victim on the return trip to the north of the Golden Gate Special, which crashed into an automobile and seriously injured its driver. In the absence of a doctor aboard, this striking instance of effectiveness of first aid treatment should impress all members of the electrical fraternity with the efficacy of knowledge of this kind.

Harry Noack of the Pacific States Electric Company, as registrar of convention delegates; **E. R. Northmore** of the Los Angeles Gas & Electric Corporation, as assignor of hotel accommodations; **Dave Harris** of the Pacific States Electric Company, as collector of prizes; **J. D. Redpath,** secretary of the Electrical Contractors' Association, as master of baggage, have won the unanimous approbation of the hundred and twenty-five enthusiastic guests aboard the Golden Gate Special for the success of this undertaking to the Southland.

The Journal of Electricity wishes to express grateful acknowledgment for valuable assistance rendered in publishing the Daily Service Issues at the Riverside Convention by **Ross B. Mateer** of the Southern Sierras Power Company as managing editor; by **Arthur F. Bridge** of the California Railroad Commission as technical editor in reporting discussions of the convention; by **R. M. Alvord** of the General Electric Company in compiling attendance data, and by **John A. Britton,** vice-president and general manager of the Pacific Gas & Electric Co., in publication of matters of public policy.

ROBERT SIBLEY, Editor.

MEETING NOTICES FOR ELECTRICAL MEN

(The National crisis has caused the calling off locally of many engineering gatherings. Its effect, too, is felt in the abandonment of the annual convention of the National Electric Light Association at Atlantic City. On the Pacific Coast, however, the opposite effect has proved true. Men of the electrical industry in an effort to keep activity as normal as possible have just completed the most enthusiastic and largely attended convention in the history of electrical gatherings on the Pacific Coast. Notations of meetings of interest to electrical men throughout the West may be found in the following lines with the exception of the convention of the Pacific Coast Section of N.E.L.A. which appears elsewhere in this issue.—The Editor.)

San Francisco Section A.I.E.E.

The regular monthly meeting of the San Francisco Section A.I.E.E. for the month of April was declared off due to the present international crisis.

San Francisco Electrical Development and Jovian League

The regular weekly meeting of the San Francisco Electrical Development and Jovian League for Wednesday, April 18, 1917, at the Palace hotel was devoted to a discussion of Coast Defense by Captain Malone, who gave a most interesting talk on the method of finding the range for modern coast defense work, in addition to much other explanatory matter connected with the organization of the national defense work.

W. L. McKinley of the Sierra & San Francisco Power Company, and Miles Steel of the Benjamin Electric Manufacturing Company, were both fined fifty cents under the new late fund rule. The money is to be turned over to the Red Cross.

Wednesday, April 25, served as an echo meeting of the recent convention of the Pacific Coast Section of N.E.L.A. H. F. Jackson of the Sierra & San Francisco Power Company, led in the discussion. He stated that the keynote of the convention was the spirit of harmony and unity that pervaded its meetings and the fact that it was the work of many pulling together instead of a few as is so often the case in such gatherings. Mr. Jackson is the newly-elected president of the Pacific Coast Section and much is expectantly looked forward to during the coming year due to his well-known executive ability.

An interesting talk on bees by John C. Froghliger followed an eloquent appeal by A. B. C. Dohrman in behalf of the National Red Cross Society. E. M. Cutting very ably acted as chairman of the day.

BUILDERS OF THE WEST—IV

HARRIS J. RYAN

It is doubtful if ever a section of country was blessed with a group of builders so broad in vision and yet so constructive in the ideals that they have put forth as are to be found in our beloved West. That the great majority of these men are either engineers or else closely allied to the engineering profession is indeed a source of gratification to all who have followed the great feats of engineering and commercial enterprise that are so characteristic of Western effort. Among the first and foremost of the Builders of the West should be mentioned Harris J. Ryan, professor of electrical engineering at Stanford University, an engineer of brilliant research attainments and respected and beloved by all with whom he comes in contact.

Los Angeles Jovian Electric League

Charles Lapworth, war correspondent, author and editor of the Los Angeles Graphic, gave the most interesting talk of the year at the luncheon on April 18th. His subject was "A Zeppelin Night in a London Newspaper Office." Mr. Lapworth was in charge of the night shift of the London Daily Mail during the early part of the war, and his graphic description of the startling events that took place in Great Britain during that time was intensely interesting. Mr. Frank M. Coker, manager of the Coker Electric Supply Company, was chairman of the day.

One hundred and fifty members, their wives and friends attended the luncheon on April 11th, the occasion being the annual celebration of Ladies' Day. A very interesting program with special features was arranged by J. H. Cunningham of the General Electric Company, who acted as chairman of the day. Albert Shiels, superintendent of public schools, the principal speaker of the day, outlined his plans for increasing the efficiency and broadening the scope of the work in the public schools in an interesting talk. His subject was "What our Schools are Trying to Do." Mrs. Martha Nelson McCann, Red Cross official, was presented with a large bag of currency representing the proceeds of the league's recent American Red Cross campaign, when five hundred fifty-four members were secured. Music was furnished by the Hubbard Musical Four.

The Technical Service Department at Portland

The technical service department of the Oregon patriotic service league, was organized Saturday evening, April 10th in the library hall in Portland, Oregon. Each engineering society has elected a representative, who is to serve as vice-president of the Oregon Patriotic Service League. These representatives are as follows: R. G. Dieck, American Society of Civil Engineers; L. T. Merwin, American Institute of Electrical Engineers; Joseph Jacobberger, American Institute of Architects; F. A. Olmsted, American Chemical Society; J. C. Henckle, National Electric Light Association; H. L. Vorse, Oregon Society of Engineers; A. G. Labbe, Technology Association of Oregon.

Geo. C. Mason, state chairman and associate member naval consulting board, has been elected chairman of the executive committee.

The technical service department of the Oregon Patriotic Service League entered the Patriotic Day parade Thursday afternoon, April 19th, in Portland, Oregon, with 500 technical men in line.

Automobile Engineers Organize at Portland

Men of engineering ability in the branches of automobile tractor and marine work will have an opportunity to associate themselves with the Society of Automobile Engineers in the plans now being advanced by that organization to co-operate with the national government in the present crisis. Elmer J. Clark, vice-president of the Portland Motor Car Company, dealers in Packard and Nash cars, who has been a member of the Society of Automobile Engineers for many years, has been appointed by the administrative officials to represent the organization in the Pacific Northwest, embracing Oregon, Washington and Idaho. Mr. Clark will en-

deavor to enlist engineers of proved ability and standing in the service and will be glad to discuss details of the society's plan with all applicants. He proposes to conduct a membership campaign for the Northwest immediately so that Oregon and her sister states may be recorded as doing their share.

Convention of N.E.L.A. Called Off

In view of present national crisis the Atlantic City convention of the National Electric Light Association has been abandoned. There will be a two day meeting in New York, May 9th and 10th, of class A and D members to discuss momentous matters in connection with war conditions. Annual routine business will also be taken up at this meeting.

The Pacific Coast Gas Association

The Pacific Coast Gas Association held its first get-together dinner of the season in San Francisco on the evening of Thursday, April 5th.

It was a memorable gathering in the history of the association. There was an excellent attendance of members from all parts of the Pacific Coast territory, and the ballroom of the Palace Hotel in which the banquet was held was appropriately draped with the national colors. It was without question one of the most enthusiastic gatherings ever held by members of this association. President C. B. Babcock, lately returned from his trip East, was in the chair and there were gathered around him men whose prominence in the gas industry is not of yesterday. The chairmen of the various standing committees reported progress, and among those called upon for remarks were Messrs. E. C. Jones, Henry Bostwick, John D. Kuster, F. A. Leach Jr., F. S. Myrtle, and M. L. Neely, all of "Pacific Service"; Leon P. Lowe, F. A. Cressey Jr., Wm. J. Dorr, T. P. Brooks, R. L. Cardiff and H. R. Basford. All of the speeches were to the point and were well received.

A feature of the evening was the adoption of the following resolutions which were transmitted by telegraph to the President of the United States at Washington and the Governor of California at Sacramento:

"Resolved, That the Pacific Coast Gas Association, in meeting assembled, tenders to your excellency the united, loyal and patriotic support of its membership, to be of such assistance to you and our nation as necessities may demand. The organization is composed of technical men who are used to problems and their solution, and bring with them in this tender of patriotic services the best wishes for you and your administration, with the assurances of loyal esteem and support."

Needless to say the adoption called for "The Star Spangled Banner" which was given with a will. It is with great pleasure that we record the receipt of the following reply from President Wilson:

"The President thanks you cordially for the good will which prompted your kind message which has helped to reassure him and keep him in heart."

An expression of sympathy and affection was transmitted to Mr. Frank A. Cressey, Sr., a charter member of the association and father of our past-president, who is confined to his home at Modesto by serious illness.

The association is now on the eve of the quarter-century mark, and while there are several of the "Old Guard" still on hand, its future destiny must rest with the younger men of the industry. That being so, it is refreshing to note the number of new members that the association is enrolling. "Good Old Reliable Gas" is doing business with greater energy than ever; in fact, from all accounts the industry is entering upon a new era of progress and prosperity. Gas men realize that they are to play a most important part in the industrial development of our country.

The second get-together dinner of the association is scheduled for Los Angeles on the evening of Saturday, June 9th. It has already been announced that the association will hold its twenty-fifth annual convention at Santa Cruz.

Annual Meeting of the Society for Electrical Development

The annual meeting of the Society for Electrical Development, Inc., will be held May 8th, at its offices in the United Engineering Societies' Building, New York City.

The society has some comprehensive sales plans to present which are expected to follow up the good work of "America's Electrical Week" and "Wire Your Home Time."

Following the annual meeting the board of directors will meet to elect officers for the ensuing year. The directors are expected to decide upon whether there should be another Electrical Week this year, or next spring, and to appoint a committee to take active charge of such a campaign.

Organization of Manufacturers of Automatic Electric Accessories

An organization of manufacturers of automatic electric accessories was formed at Atlantic City, New Jersey, Monday, April 16, 1917. The new organization will be known as the Automatic Electric Association. Among its members are the largest and best known manufacturers in this line. The purposes of the organization are to improve and develop this branch of automatic electric accessories' business through standardization and by friendly interchange of experience to design and manufacture. The following officers were elected at this meeting: G. Brewer Griffin, president, Pittsburgh, Pa.; C. O. Mininger, vice-president, Toledo, O.; G. S. Cole, secretary, Cleveland, O.; C. L. Amos, treasurer, Syracuse, N. Y.

The next meeting of this association will be held at Hot Springs, Va., May 17th, 18th and 19th.

UTILITY NOTES

Notes of Utah Utility Commission

Governor Simon Bamberger of Utah has named Judge Joshua Greenwood of Nephi, and Warren Stoutnour of Salt Lake City, and H. H. Blood of Kaysville on the public utilities commission created by the law recently enacted.

Judge Greenwood is a native of Utah. He is a lawyer by profession and for several terms has filled the position of judge of the Fifth Judicial District, which position he held until the time of his appointment to the commission.

H. H. Blood is prominently identified with the industries of Utah. He is manager of the Kaysville Milling Company and holds several directorships in Davis County banks, mercantile establishments and real estate companies.

Warren Stoutnour, the third member, is an engineer by profession. He was born at Everett, Pa., and is thirty-five years of age. He graduated from Lafayette College at Easton, Pa., in 1903 with the degree of civil engineer. While in school, he worked with the United States Geological Survey during his vacations. After graduation he came West and worked for the O. S. L. Railroad Company for six years, during which period he had a wide experience in railroad construction work. He then went to the Pacific Coast, where he was engaged as superintendent for various general and public constractors. In 1912 he returned to Utah and entered the employ of the Salt Lake & Ogden Railroad Company, the Bamberger electric line, as superintendent of construction which position he held at the time of his appointment to the commission. During this period he designated the bridges for the Utah Railroad Company, who were building a railroad from the Carbon County coal fields to Salt Lake City.

Western States Gas & Eectric Company

Western States Gas & Electric Company, Eureka, Cal., division, is negotiating for the power requirements of a local paper mill, amounting to approximately 400 horsepower in motors. William P. Bonbright & Company, Inc., and H. M. Byllesby & Company, have underwritten and will offer to the public a new issue of $1,564,000 six per cent gold notes of the Western States Gas & Electric Company of California. The notes are due February 1, 1927. The proceeds will provide funds for the retirement of $621,000 notes and for extensions and additions to the properties, and payment for recently acquired water rights and storage reservoirs on the south fork of the American River.

The Public Utilities Commission of Idaho

In the matter of the application of J. E. Goodman of New Meadows, State of Idaho, for a certificate of convenience and necessity to furnish electricity to the towns of Donnelly, Arling, Cascade, and the incorporated villages of Roseberry, and Van Wyck, all of Boise County, Idaho, the commission granted the request.

Notes of California Water Commission

Ed Fletcher of San Diego has applied to the State Water Commission for permission to appropriate 8 cubic feet per second of the waters of Escondido Creek in San Diego County for irrigation. The proposed works consist of a diversion and storage dam 140 ft. high, 400 ft. long on top and 200 at the bottom of concrete construction, capable of storing 12,011 acre feet of water, and two miles of main canal. The number of acres it is proposed to water is given as 3600 and the estimated cost as $250,000.

In one of the most important applications received recently, the Southern California Edison Company of Los Angeles, has applied to the State Water Commission for permission to appropriate 600 cubic feet per second of the waters of the North Fork of the Kern River and of Salmon Creek in Tulare County for the generation of electric energy. The application sets forth that on September 6, 1901, the California Power Company appropriated waters of Kern River for power purposes by posting notices of appropriation and on January 27, 1902, appropriated waters of Salmon Creek by like method, as was the law at that time; that applicant has since become vested with all the rights acquired by the California Power Company. The application then specifies the work done since the making of the original appropriations, the amount expended being given as $881,704.05. The estimated cost of completing the project, exclusive of transmission lines is given as $4,118,295.45.

The name of the works is Kern River Plant No. 3, and the following is a partial description given in the application: Diversion dam 60 ft. high, 240 ft. long on top and 200 at bottom, the top of the dam being 13 ft. above the ordinary water surface. The construction is to be of concrete with headgates in steel guides. The conduit is 13.4 miles long. Under the heading of "canal system" the application states that for 1000 ft. there is an open canal with concrete sidewalls with appliances for drawing off sand from the water. At the lower end of the sand-box system, a tunnel system commences, running to the fore-bay, except in certain places where reinforced concrete flume will be used. All tunnels are to be lined with concrete on bottom and sides. At 11.9 miles below dam, the tunnel crosses a gulch with a steel syphon pipe 9 ft. in diameter. From the forebay to the power house the water will be conducted in two steel penstocks seven feet in diameter at upper end and five feet at lower end. It is proposed to develop the power by two hydraulic turbines, direct connected to alternating current electric generators with a total capacity of 30,000 kw. The total fall to be utilized is 800 ft., between the forebay and the tail-race and the amount of power to be developed is given as 54,545 theoretical horsepower. The power house is to be of concrete. The application states that the proposed plant is to supplement the present plant of the company to meet the increasing demand for light and power, and it asks until July 1, 1922, to complete the constuction.

The city of Los Angeles has filed three more applications with the State Water Commission asking permission to appropriate waters at three different points for the purpose of generating electric power for the general power project outlined by that city. There are several other applications before the commission for the same project, each one of which represents a unit of the proposed municipal enterprise of the southern city. Fifty-six cubic feet per second is asked on Rock Creek, tributary to Owens River in Inyo County. The only data given on this application is that there is proposed a canal six miles long. It is to be known as the Rock Creek project. Permission is also asked to appropriate 10 cubic feet per second of the waters of Sawmill Creek, also tributary to the Owens River, this to be known as the Sawmill and Division Creek project. Nineteen cubic feet per second is asked from the waters of Baker Creek, tributary to the Owens River to be known as the Baker Creek project. The submission of complete data will be required before the applications can be acted upon by the commission.

BOOK REVIEW

Operation of Gas Works. By Walter M. Russell. Size 6 by 9 in.; 209 pp.; 76 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York City, and for sale at the Technical Book Shop, San Francisco. Price $2.00.

In this book the author, who is manager of the Emporia Gas Company has endeavored to present the facts and details of gas works management in concise and readable form. This book is intended to supply the needs of foreman, superintendent, engineer or cadet, connected with a small or medium-sized gas works, who desires to increase and widen his knowledge of the principles and practice of gas making. No extended description of machinery or apparatus is attempted but rather the aim has been to give as simply and clearly as possible instructions for operating the standard types of apparatus usually found in gas works together with some discussion of the principles involved. The treatment of the text is taken up under six main headings: Organization and management, chemical control, coal gas, water gas, general plant operation, and calorimetry and photometry.

To western gas engineers whose duties are largely devoted to manufacture of oil gas this treatment of practice in coal and water gas plants will prove extremely useful for reference and study in co-ordination of the industry.

NEW BULLETINS

The Benjamin Electric Manufacturing Company has just issued most attractive publicity matter setting forth data to assist in the "Wire Your Home Time" campaign which is now being pushed as a national campaign.

The March Bulletin of the Philadelphia Electric Company is especially attractive and interesting in that it discusses a problem of vital import to other communities throughout the West, namely the rehabilitating of dwellings twenty-five to thirty years old.

The Crocker-Wheeler Company has issued Bulletin 176 on "Form R Induction Motor"; Bulletin 175 on "Form I Direct-Current Machines"; Bulletin 174 on "Form L Direct-Current Machines"; and Bulletin 173 on "Slot-Bridge Construction for Induction Motors."

Bulletin 72, just issued by the California State Mining Bureau, is entitled "The Geologic Formation of California with Reconnaissance Geologic Map." The extent and availability of our petroleum resources, which are so important in modern naval operations, are thoroughly covered by the Bureau in its work of protecting the fields from damage by faulty operations.

"Combustion in the Fuel Bed of Hand-Fired Furnaces" is the title of Technical Paper 137, by Henry Kreisinger and others, which has just been issued by the Bureau of Mines of the Department of the Interior. The main object of the investigation was to determine the conditions governing the process of combustion in the fuel bed of a hand-fired furnace. The results of this investigation furnish data for correct design of coal-burning grates and furnaces and their efficient operation. They also cast light on the important problem of clinker trouble as related to fusibility of ash. They further indicate the possibility of a high rate of gasification of coal in gas producers.

LATEST IN EVERYTHING ELECTRICAL

(The proper disposition of solid particles conveyed out into the open in waste gases has been a difficult and obnoxious problem in the industries of the West. Here is a description of a process that is proving eminently satisfactory in many quarters. The process is especially interesting and instructive to readers of the Journal in that a peculiar property of electric magnetization is made use of to accomplish its effective results. Other notations on recent advances in affairs electrical follow this description.—The Editor.)

EQUIPMENT NECESSARY FOR THE COTTRELL PROCESS

Standard 100,000 volt, 15 k.v.a. Westinghouse Cottrell Transformer

By means of the Cottrell process, which is an electrostatic method of precipitating the fine solid particles carried by a moving gas through a flue, the suspended matter in smoke may be removed, cement dust cleared from the gasses generated during the process of manufacture, and flue dust removed from the gasses emanating from blast furnaces, roasters, converters, and the like. The process, which is widely used commercially to recover the metalic contents in smelter smoke and the fine dust produced in cement mills, is controlled by Dr. Cottrell and made available for use by the Research Corporation, New York, and the Western Precipitation Company, Los Angeles, California.

The usual Cottrell treater consists of a series of tubes, either rectangular or round in shape. In the centers of these tubes fine wires or chains are suspended, the wires or chains forming one electrode and the inner surface of the tubes the other electrode. As the surface of the wire or chain is very much less than the surface of the tube, far greater ionization takes place from this small electrode than from the tube surface. The gas thus receives a static charge of the same polarity as the suspended electrode, and the solid particles in the gas are projected against the inner surface of the tubes, where they tend to stick and accumulate until the electric current is turned off. The dust may then be loosened by rapping the sides of the tubes, and is collected in hoppers at the bottom.

The high static charge necessary for the suspended electrodes, is obtained by a unidirectional high voltage current of sometimes as high as 100,000 volts direct current, which is produced by rectifying a high tension alternating current. The high tension alternating current is secured from the regular alternating current supply by means of step-up transformers especially designed for the process. The rectification of this high tension alternating current is usually accomplished by means of a mechanical commutating switch or rectifier as it is called, run in synchronism with the low tension alternating current supply circuit.

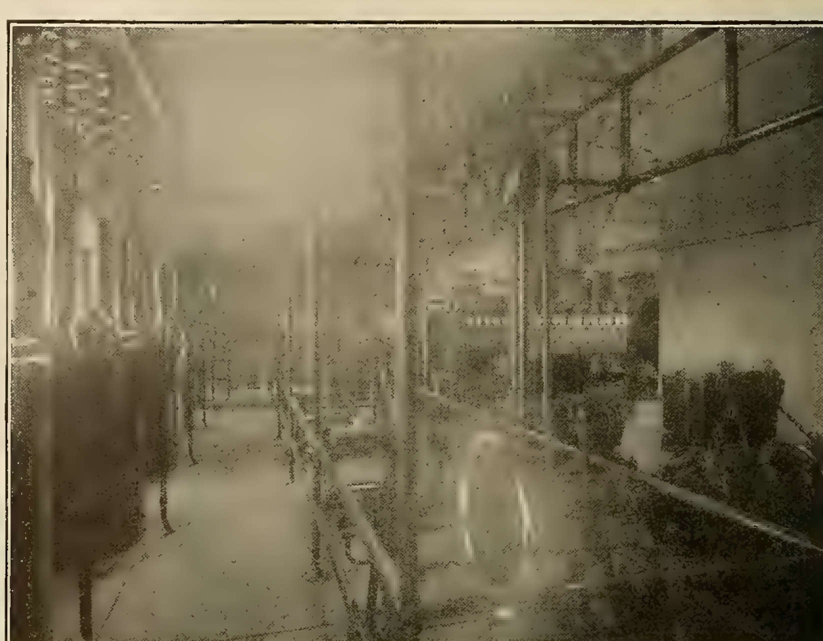
The rectifiers are connected in the high tension circuit between step-up transformers and treaters. Balancing inductance and resistance are usually inserted in the high tension circuit to partially neutralize the electrostatic capacity of the treater and to bring the power factor up into the neighborhood of 80 per cent, leading.

To meet the requirements of this process, the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has developed special apparatus for supplying the electric power required. The equipment furnished, which consists of a single-phase generator; small synchronous induction motor, a step-up transformer, and a switchboard with control devices, has been designed particularly for the work in question, along lines and suggestions made by Dr. Cottrell and the engineers of the companies controlling the process.

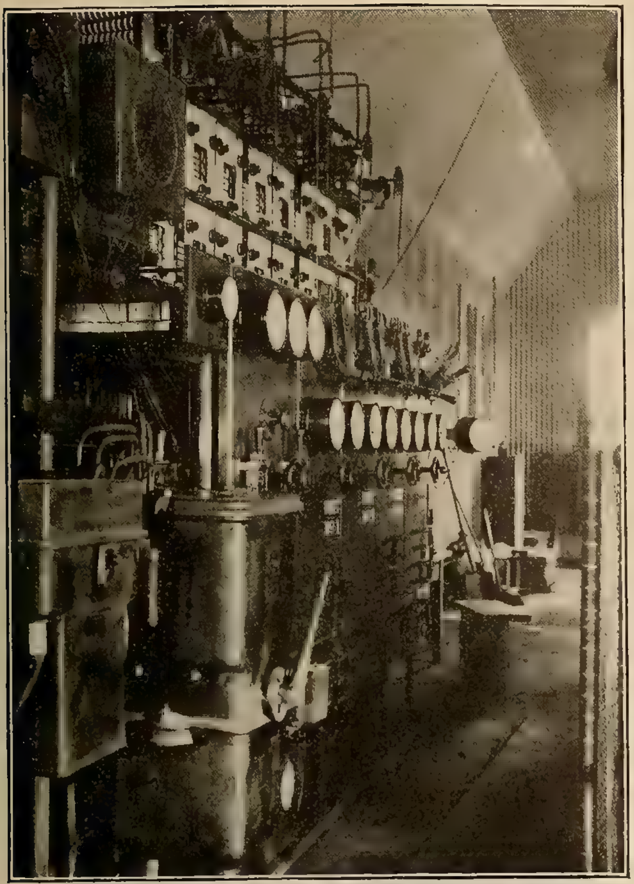
The generators, which serve to furnish the low tension alternating current required by the transformers, are for operation on single-phase, 60-cycle circuits and are of the four pole, adjustable voltage type. Three sizes are supplied, having capacities of 15, 25 and 75 k.v.a. respectively. The generators are wound for a maximum voltage of 250 volts alternating current and are provided with fields for 125-volt direct current excitation. They are normally rated at 220 volts alternating current and will generate full rated current at voltages of from 110 to 250 volts. Field control of the voltage is obtained by means of a field rheostat of proper capacity for the range of voltages specified.

To drive the mechanical rectifiers when same are not driven by coupling to the generator shafts, small synchronous induction motors are furnished, in polyphase form only, for operation on 220 and 440 volts, 25 or 60 cycles.

The standard Cottrell transformers furnished are de-

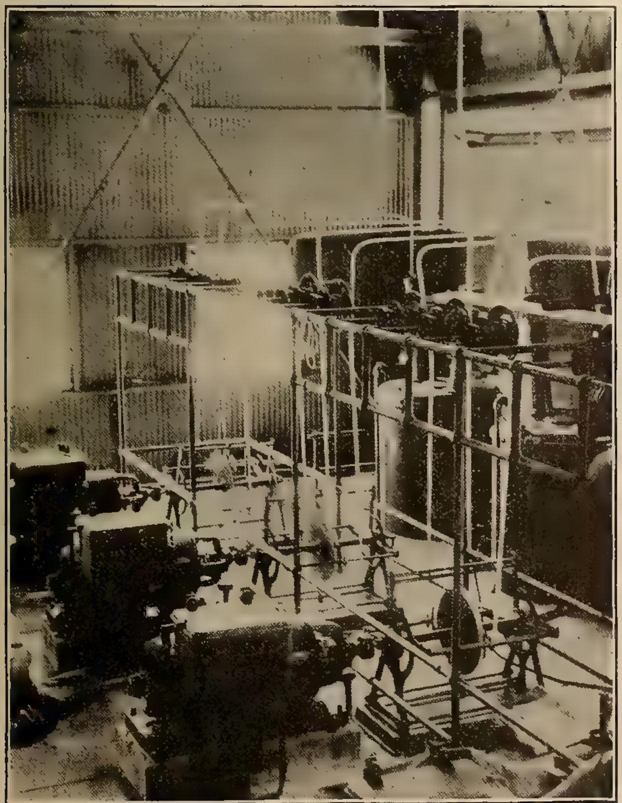


Motor Generator Sets with Rectifier Direct Connected, showing Exciter Sets, Transformers and Switchboard



Typical Switchboard for Cottrell Units

signed for use on 25 and 60-cycle circuits. For 25-cycle circuits the capacity of the transformers regularly furnished is 10 and 20 k.v.a.; for 60 cycles, 15 and 25 k.v.a The transformers are furnished with low tension for either 200, 220 or 440 volts, though 220 volts is considered standard. The standard high tension voltages are 100,000, 60,000, and 40,000 volts, maximum.



Motor Generator Sets with Starters, Direct Connected to Rectifiers, Transformers to Right

For high tension voltages of 50,000 volts and over the transformers are provided with condenser type terminals. All transformers for 40,000 volts and over have a small oil immersed choke coil mounted within the case between the end turns and the high tension terminals. Transformers for over 50,000 volts have, in addition, choke coils mounted one on each high tension terminal outside of the case. The transformers are mounted in substantial boiler iron cases with welded seams, and are provided with cast iron taps through which both high and low tension terminals are brought through suitable bushings.

As the value of the high tension direct current voltage at which the treater will give best results varies with the constituency, temperature and velocity of the gasses passing through it, as well as with the barometric condition of the surrounding atmosphere, it is necessary to vary and control the voltage supplied to the treaters. This is accomplished by varying the low tension voltage of the step-up transformer, either by impressing the low tension supply voltage on different taps in the low tension winding, for large variations, or by minor adjustments in the voltage supplied to the low tension winding of the transformer when the variation is small in range.

While the switchboard equipment for the control of Cottrell apparatus is usually built to meet the requirements of individual plants, certain control apparatus is embodied in all of it. In general, there are three different arrangements utilized, the switchboard equipment for each varying somewhat. The switchboards are arranged either for the control of motor-generators and transformer when each transformer is fed from its own generator; for the control of both motor-generator sets and transformers when several transformers are fed from one generator, or for the control of transformers fed from constant potential lighting or industrial circuits.

The source of low tension alternating current may be either a constant potential single-phase industrial or lighting circuit, or it may be furnished by a single-phase alternating current generator. The use of a constant potential industrial or lighting circuit for the transformers has an advantage in that it eliminates the cost and losses of a separate generator as well as the driving power for same, tending to reduce the total cost of the installation and to improve its efficiency slightly. However, the saving in both costs and the improvement of efficiency is not of great magnitude when compared with the total first cost and the operating cost of the complete treater. On the other hand, the use of a separate generator as a source of low tension supply, has several advantages, in that it eliminates from the treater operation any variation in the voltage of the supply circuit, frees the supply circuit from any disturbances in the treater, and somewhat simplifies the voltage control.

A FORCEFUL SALES PLAN TO POPULARIZE VACUUM CLEANERS

A timely and forceful sales plan has recently been introduced by the Hotpoint Electric Heating Company of Ontario, California, manufacturers of the Hotpoint Vacuum Cleaner, whereby the Hotpoint distributer is materially assisted in selling the cleaner on the installment plan.

A special form of coupon bond certificate is furnished the Hotpoint distributer with every cleaner purchased. The certificate is simply worded, and is in the form of a note, being a promise to pay, and is negotiable. To each certificate is attached a generous supply of coupons. Each coupon is blank, as far as the amount of payment and the time limit of the special offer is concerned, it being left to the discretion of the dealer to make his own terms.

Our correspondent writes that while similar plans have been used in marketing various forms of merchandise, the very forcefulness and timeliness of this plan is making it a success.

ELECTRIC DRIVE FOR BATTLESHIPS COLORADO AND WASHINGTON

Contracts totaling approximately $2,000,000, have been placed recently with the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., by the New York Shipbuilding Company, for furnishing the necessary electrical equipments for the propulsion of the new superdreadnaughts Colorado and Washington.

The equipments to be furnished are practically duplicates of that contracted for by the Navy Department for the U. S. S. Tennessee now building at the New York Navy Yard. The four propellers as in the case of the Tennessee, instead of being mechanically connected to driving engines or turbines, are to be driven by individual motors. The current for the motors will be furnished by two turbine generators.

THE STANDARDIZED MASTER CATALOG INDEX

In the six months since the Master Catalog idea was presented to the National Association of Purchasing Agents, buyers, salesmanagers and publishers have almost unanimously favored the plan as outlined.

The details of the most important parts of the master catalog remain to be developed to their fullest extent. For instance the index to this Master catalog must be standardized for two important reasons: Sales managers want their printed matter to secure for them the greatest possible benefits and therefore they must know exactly how to arrange and index their lines of goods to be sure that when the buyer refers to his catalog he will find their sheets or books. Buyers must be able to feel that, when they have looked in a certain definite place in their master catalog, they have there found all their available data. "One place for everything and everything in its place."

It remains for each industry to look after its own interests and to see that those who are most thoroughly familiar with its particular requirements, and who are best qualified to plan its section of the index are invited to co-operate in that work. Herein lies an opportunity for very effective construction work on the part of the various trade journals and associations for the general benefit of all the members of their industry.

Anyone desiring to co-operate in the development of Standard Master catalog should communicate with W. L. Chandler, assistant treasurer Dodge Sales & Engineering Company, Mishawaka, Indiana.

PROOF THAT ADVERTISING LOWERS SELLING COST

The rising cost of living is the great universal hardship of the present day. So great and so many have these rises been that few people stop to realize that there have been any exceptions to the general rule. But the fact is that there have been numerous exceptions and all of these exceptions belong to the same great class—that of nationally advertised goods.

The old idea that the cost of advertising raises prices dies hard. But the business man knows better. He knows that selling goods is costly business—no matter what the goods or what the selling methods. And he knows that anything which creates demand on a large scale, and thus makes selling easier, is bound to reduce selling costs and thus helps to reduce prices.

But evidence is better than argument; facts are better than theories. The Association of National Advertisers, an organization of 260 of the leading advertisers of the country, has been at great pains to collect the facts. It has secured an immense body of data from its members which proves that advertising does reduce selling costs and thus tends to reduce the selling price of advertised goods. A few representative cases will suffice.

The makers of a famous photographic camera, when they began advertising twenty-eight years ago, made one camera which took a 2½ inch picture and which sold at $25. Today they make a far better camera which sells for $10.

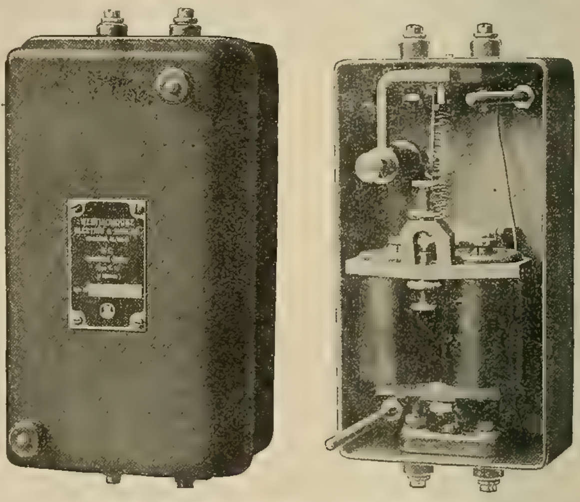
When the manufacturer of a famous breakfast food specialty began advertising, his goods sold at 15 cents a package. Today the package is fifty per cent larger and the price has been reduced to 10 cents.

Then take the most conspicuous example of them all—the automobile business; and compare the $5000 or $10,000 cars of ten years ago with the equally good cars of today, selling for a fraction of the money.

"A triumph of economical marketing" is the only possible verdict for advertising in the face of these facts.

WESTINGHOUSE DIRECT CURRENT OVERLOAD RELAY

The relay illustrated has been developed by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh Pa., to give overload protection on direct current circuits. It is particularly applicable for use in connection with three-wire generators having but four cables running to the switchboard, as by connecting the control coil of the relay to ammeter shunts the circuit breakers can be mounted on the switchboard, yet controlled by the actual armature current as required by the Fire Underwriters. Without the



A New Direct Current Overload Relay

relay the circuit breaker must be insertd in the circuit breakers can be mounted on the switchboard, yet controlled by the actual armature current as required by the Fire Unrelay the circuit breaker must be inserted in the circuit at the position of the ammeter shunt. This would require either that the circuit breaker be mounted at the generator, away from the switchboard, or that an extra pair of leads be run from the generator to the switchboard.

This relay is known as the type TO. The operating part is a two-pole electro-magnet with special winding. This, and an adjusting mechanism are enclosed in a dust proof case of aluminum alloy.

TRADE NOTES

William P. Bonbright & Company, incorporated, announce the removal of their offices to the Equitable Building, corner Nassau and Cedar streets, New York, April 9, 1917.

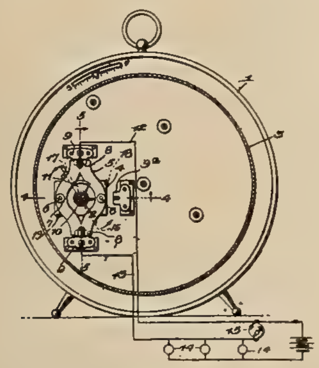
The Colorado Power Company has signed a new contract for an electro-metallurgical installation for a manufacturer of ferro-tungsten, providing for 600 kilowatts of use and producing a yearly gross income of about $25,000.

WHAT WESTERN INVENTORS ARE DOING

(The electric sign continues to be a profitable load builder for the central stations throughout the West. Inventors have in the past shown considerable ingenuity in perfecting electric advertising devices. In the following lines may be found a new invention for such a device, together with other descriptive briefs of inventions perfected by men throughout the West.—The Editor.)

1,221,216. **Time-Controlled Switch.** George R. Pyper, Midvale, Utah.

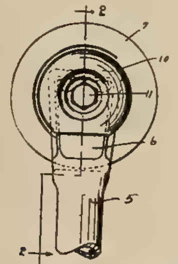
A manually set time-controlled rotary shaft, a circuit closing member mounted upon it to be limited to a number of movements, a trio of stops spaced on an arc described around the



shaft, and a hand key having a portion extending laterally from the shaft for contact with the stops, the key being pivoted to the shaft to allow it to be rocked manually in order to clear the intermediate stop.

1,221,763. **Trolley.** Joseph McMillan, Glendale, and Clarence V. Greenamyer, Los Angeles, Cal.

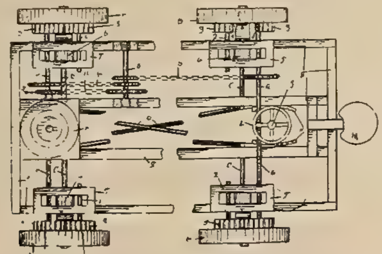
A trolley harp guard comprising plates secured upon the axle of the trolley wheel, the plates having the edges



curved to lie within and close to the flange of the trolley wheel and being chambered at the central portions to receive and protect the fastening means on the ends of the axle of the trolley wheel.

1,221,320. **Tractor.** Martin Hansen, Salt Lake City, Utah.

A self propelled vehicle the combination of four traction wheels; a stub axle for each wheel; an annular gear concentrically secured on each of the wheels; a wheel pivot for



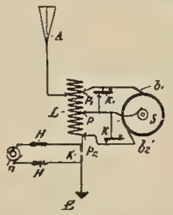
each of the gears; a frame mounted on the pivots; two reaches each of which is pivoted to the inner ends of one rear and one front axle; means to suspend the reaches from the frame and allow longitudinal movement thereof; a rack on the front portion of each of the reaches with the teeth turned inwardly; a gear whose teeth mesh with the teeth of the racks; and means to rotate the gear and thereby to have the axles on the pivots.

1,221,430. **Airship.** Alfred Extrand, Aberdeen, Wash.

An airship, a hull, a horizontal diaphragh extending longitudinally through the hull dividing it into upper and lower compartments, transverse partitions extending across the upper compartment to subdivide it into cells, means for filling the cells with a gas lighter than air, vertical longitudinal partitions extending along the lower compartment to form a

passageway, transverse partitions subdividing the lower compartment on opposite sides of the passage-way into staterooms and air-chambers with each state-room communicating with an air-chamber, means for compressing air within the air chambers, and means for controlling the communication between each state-room and its respective air-chamber to regulate the flow of compressed air from the latter to the former.

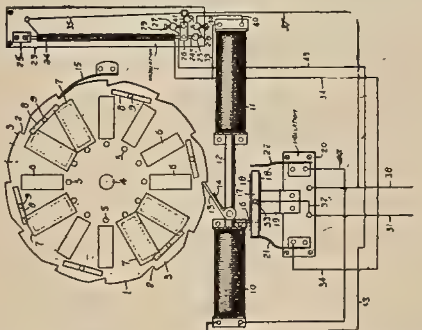
1,221,033. **Wireless-Telegraph Signaling System.** Lee de Forest, San Francisco, Cal., assignor to Radio Telephone & Telegraph Company, a Corporation of Delaware.



A system for multiplex wireless signaling, a radiating antenna system, key controlled circuits associated therewith, keys for controlling the circuits and means for automatically shunting the keys in succession.

1,219,933. **Electric Advertising Device.** William Cochran Gillespie, Phoenix, Ariz.

The combination with a rotatable disk, of means for intermittently rotating the disk, the means comprising a pair



of solenoids, a common core for the solenoids, means connected with the common core for rotating disk, and thermostatic means for controlling the solenoids.

NEW ELECTRICAL DEVELOPMENTS

(The most important new electrical development of the past semi-monthly interval is the beautiful and inspiring resolution adopted at the Riverside convention in which the representatives of a half billion of dollars in hydroelectric investments in California, Arizona, Nevada and New Mexico tendered to the government of the United States their all to assist in necessary transportation, manufacture of munitions of war, in shipbuilding, the raising of food stuffs and other necessaries of life. Other notations on new electrical developments throughout the West may be gleaned from the following pages.—The Editor.)

FINANCIAL

MEDFORD, ORE.—The Oregon Gas & Electric Company of Medford ran behind $11,458 last year, according to its annual report filed with the public service commission. Its operating revenues for the year were $37,592 and its operating expenses $45,242. Taxes came to $7650 and there were other deductions.

NEWBERG, ORE.—The Yamhill Electric Company of Newberg, according to its annual report filed with the public service commission at Salem, received a net income of $11,194. Its operating revenues amounted to $37,011 and its operating expenses were $23,870. It paid a 6 per cent dividend on $100,000 of common stock.

California-Oregon Power Company

(Operating in Yreka, Dunsmuir, Montague and vicinity, and in Oregon).

Total fixed capital	$16,293,082.44
Total assets	19,727,604.00
Capital stock	10,000,000.00
Reserves	349,330.46
Gross corporate income	106,220.50
Net corporate loss for year	183,204.56
Deficit on December 31, 1915	123,681.86
Deficit on December 31, 1916	365,386.31

Northern California Power Company

Income account for 1916:

Operating revenue	$853,125.84
Operating expenses	371,702.34
Net operating revenue	481,423.50
Non-operating revenue	6,550.50
Gross corporate income	487,974.00
Non-op. revenue deductions	2,228.32
Interest accrued on funded debt	352,920.37
Miscellaneous deductions	4,603.18
Total deductions	359,751.87
Net corp. income for year	128,222.13
Miscellaneous additions to income	57,038.56
Miscellaneous deductions from income	188,375.15
Surplus on December 31, 1915	239,603.15
Surplus on December 31, 1916	236,488.69

ILLUMINATION

GREAT FALLS, MONT.—Proposals closed April 10 for constructing a complete street lighting system in S. I. D. No. 299.

PORTLAND, ORE.—City Commissioner Daly has added to his estimate for a municipal light plant $350,000 for an auxiliary steam plant.

LOS ANGELES, CAL.—The board of education has called for bids for installation of electric fixtures in the Jefferson High School.

VALLEJO, CAL.—The contract for municipal lighting for the coming year has been awarded to the Vallejo Electric Light & Power Company.

PALOUSE, WASH.—The Washington Water Power Company will rebuild the power plant under terms of 25-year franchise passed by the council.

OTHELLO, WASH.—The council decided to equip a municipally owned lighting plant, also to make extensive improvements to the water system; cost about $14,000.

LOS ANGELES, CAL.—The board of supervisors has accepted the bid of the city of Glendale for furnishing additional lights and supplying lighting current for the Verdugo Lighting District.

EUREKA, MONT.—The council passed an ordinance calling a special election to pass upon the matter of granting an electric light and power franchise to J. J. Tetrault et al. The proposed plant will cost about $60,000.

SANTA BARBARA, CAL.—A blanket franchise to permit the laying of gas pipe lines along every highway in the county outside of incorporated cities has been applied for by the Midland Counties Public Service Corporation.

SANTA BARBARA, CAL.—The Midland Counties Public Service Corporation has applied for a franchise to lay and for a period of 50 years to maintain a system of gas pipe under and along public roads and highways in Santa Barbara County.

LOS ANGELES, CAL.—A petition has been filed with the board of supervisors asking for the establishment of a highway lighting district to be known as Jefferson Lighting District of Los Angeles County. A hearing will be held April 30.

BAKERSFIELD, CAL.—The franchise for laying a pipe line to distribute natural gas in the town of McKittrick was sold by the Kern County Board of Supervisors to the Producers' Gas & Fuel Company. The gas will be piped from the Midway.

GREENVILLE, CAL.—The Pacific Gas & Electric Company will soon extend its electric line three miles farther out the Stockton road to Greenville, having secured the signatures of 25 subscribers along the way who desire light or power service.

LOS ANGELES, CAL.—The board of supervisors has granted to the Los Angeles Gas & Electric Corporation, a franchise to lay, construct and maintain certain gas pipes, in, under and along certain public roads and highways in Los Angeles County.

SEATTLE, WASH.—City Architect Daniel Huntington has completed plans for the construction of a one-story addition to the auxiliary steam power plant on Eastlake and Nelson Place; cost is to be between $75,000 and $80,000, by day labor. Bids will be called at once for driving 6000 ft. of piles for the foundation.

SANTA MONICA, CAL.—The city council has ordered the improvement of a portion of Second street between Utah avenue and Santa Monica boulevard by the installation of ornamental cast iron lighting posts with all wires, pipes, conduits, lamps, necessary for street lighting.

ARCADIA, CAL.—The board of trustees has awarded the contract for improvement of a portion of First avenue, to the Southern California Edison Company, on its bid of $1400 for installation of 29 reinforced concrete ornamental street lighting standards together with wires, pipes, conduits, globes, lamps and all accessory fixtures.

LODI, CAL.—The Sacramento Natural Gas Company has submitted to the board of city trustees a written offer for the sale of its plant to the city, which Manager C. H. Keyes said would be done following the agitation for a municipal system. The offer makes two propositions, one of $74,874.12 which Keyes declares is 20 per cent less than its cost or to fix a price through a board of arbitration, consisting of two engineers, one named by the city and the other by the gas company. If these engineers cannot reach an agreement they will be allowed to call in a third and the company will take 10 per cent less than the amount fixed.

TRANSPORTATION

SAN FRANCISCO, CAL.—The Supervisors unanimously adopted the resolution appropriating $116,000 of the Municipal Railway funds for the building of additional tracks on Market street line with the Van Ness avenue tracks.

SAN DIEGO, CAL.—The San Diego Electric Railway Company proposes to connect its University Heights lines and its Mission Hills line by constructing a cut-off between First and Washington streets and Fifth and University avenue.

TACOMA, WASH.—Superintendent J. F. Richards of the C., M. & St. P. railway says that the substation to be used in connection with the electrification of the Tacoma terminals will be 85 or 90 ft. by 60 to 75 ft. and will cost $175,000. It will eb located on the Tacoma tideflats.

JACKSONVILLE, ORE.—An ordinance has been passed by the city council granting to the Southern Oregon Traction Company a franchise for the construction, operation, use and maintaining of a railway along certain streets and highways in the corporate limits of the city of Jacksonville, Oregon.

BIG PINE, CAL.—A survey has been completed for an electric railroad and power line from Olanch on the broad gauge railroad to the property of the Darwin Lead & Silver Mines & Development Corporation at Darwin. It is the intention of the company to proceed with building of this road and power line this fall.

KLAMATH FALLS, ORE.—A resolution has been passed by the city council calling for bids for the construction of the Klamath Falls Municipal Railway. The road will extend from Second street and Klamath avenue, in this city, to a point near Dairy Station, 20 miles east, and will form a link in the Oregon, California and Eastern Railroad.

BISHOP, CAL.—Following its purchase of the Defiance, Independence and other mines of the Darwin District, the Darwin Development Company announces that it will at once begin the construction of an electric railroad along the south shore of Owens Lake to connect with the Southern Pacific standard track at Olancha. The distance is 23 miles.

GLOBE, ARIZONA.—The Globe-Miami Electric Railway Company has been incorporated here with Harvey T. Lynch, president of the company; J. J. Mackey, vice-president; Edgar Sultan, secretary-treasurer and Frank J. Dains, general manager. The company will build an electric railway from Globe to Miami. Engineers to survey the route have been engaged and will commence operations shortly. It is expected that the first rails will be laid within 60 days.

TRANSMISSION

ALHAMBRA, CAL.—The Pacific Electric Railway Company will erect a substation here, the work to begin in a short time.

FOLSOM, CAL.—The Pacific Gas & Electric Company has completed plans for reconstructing its entire system in Folsom.

LOS ANGELES, CAL.—It has been announced that it is intended to submit a proposed $12,000,000 power bond issue to the people at the coming general election to be held June 5th.

SEATTLE, WASH.—Bids will be received soon for the generating station of the proposed $3,000,000 hydroelectric plant, plans having been approved by the board of public works.

LIVINGSTON, MONT.—Question of installing a better street lighting system has been taken up by the council with the Montana Power Company. Definite action is expected very shortly.

GLASGOW, MONT.—The Knight Electric Company of Glasgow, has been awarded the contract for furnishing and installing the Oswego electric plant by the county commissioners. Cost, $2700.

SHELTON, WASH.—Irene Richardson, auditor of Mason County, reports the Mason County Power Company has filed an application for a franchise to erect transmission lines throughout Mason County.

BAKER CITY, ORE.—The county court yesterday granted a franchise to the Baker Mines Company to construct a power line from Halfway to Cornucopia for the purpose of furnishing power for the operation of the mine.

LOS ANGELES, CAL.—The city of Los Angeles has filed with the state water commission three applications asking permission to appropriate waters at three different points for the purpose of generating electric power.

TOUCHET, WASH.—The Pacific Power & Light Company will erect a transmission line 16 miles to this town this spring. The power plant on Priest River will be tapped and a substation erected. About 18 miles of wiring will be strung in Touchet.

RED BLUFF, CAL.—The Northern California Power Company has purchased the V. B. Taylor power plant and water rights located on 80 acres of land near Manton. The power company will improve and extend the producing powers of the plant.

TWIN FALLS, IDAHO.—A proposition to put Blue Lakes into the city with Clear Lakes power, at the same time to furnish power for electrical light and power to the municipality for a total sum not to exceed $830,000, is the plan of George W. Sturtevant.

PASCO, WASH.—The Franklin county commissioners have granted a 50 year franchise to the Pacific Power & Light Company to construct electric transmission lines throughout Franklin County, it is presumed, with the Washington Water Power Company line at Lind.

OXNARD, CAL.—The Ventura County Power Company is placing a line of new poles in the alley running between Fifth and Sixth streets to prepare for the removing of the poles on Fifth street. This work is but part of a general program of improvement. The entire system in the city is being put in first class condition.

SEATTLE, WASH.—Work will be started some time this week on the construction of a one-story addition to the auxiliary steam power plant for the city on Eastlake avenue and Nelson place at a cost of between $75,000 and $80,000. Work will be done by day labor. The building will be 80 by 89 ft. of reinforced construction.

OROVILLE, CAL.—Officials of the Pacific Gas & Electric Company have announced that within the next two weeks they will start reconstruction on a larger scale of their plant at the foot of Huntoon street. The company, within another month, also will start tearing down its lighting system in the business district, replacing the present arcs with those of more modern design.

WALLA WALLA, WASH.—The city of Touchet is to be supplied with electricity this spring according to an announcement made by Manager C. S. Walters of the Pacific Power & Light Company. Electricity will be obtained by tapping the big power line from the Priest Rapids plant to this city. A substation will be constructed in Touchet and will be equipped with a 66,000-6,600 step-down transformer.

SEATTLE, WASH.—The Stone & Webster Corporation, will start work this summer on its $1,000,000 electrical power plant on the Baker River for the electrification of the Great Northern Railway, or the Chicago, Milwaukee Railway, between Seattle and Bellingham, Wash. Frank Walsh, assistant superintendent of the company, states that construction offices have been opened in the Electric Building where an engineering force is being secured.

OROVILLE, CAL.—The Pacific Gas & Electric Company announced that the old substation on the Marysville road, which was destroyed by fire two years ago, would be rebuilt and put into service again by the company. Other important rebuilding work is being done or contemplated by the company for the near future and Manager Ed. Johnson is starting in to keep his promise and to give Oroville a fine light and water service.

SALEM, ORE.—A power plant which will cost $200,000 is proposed for Harney County, about 75 miles south of Burns, according to an application for a permit filed in the office of the state engineer. The application was filed by Scott

Catterson, who seeks to appropriate 40 second feet of water from the Donner and Blitzen River for the development of 2171 horsepower. It will be necessary, according to the plans, to construct a canal and pipe line nine miles long and construct a concrete dam 60 ft. in length.

TACOMA, WASH.—It has been announced that a substation will be built near the Tacoma shops of the Milwaukee Railway Company for the operation of the Milwaukee railway lines west of the Cascades. The cost of the shops will be $175,000. Power for the main line operation will be furnished by the Puget Sound Traction, Light & Power Company and will be generated from the Snoqualmie Falls plant. The $175,000 cost includes the erection of substations at Taunton, Doris, Kittitas, Cle Elum, Hyak, etc.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the California Water Commission for the right to appropriate water from the North Fork of the Kern River and from Salmon Creek in Tulare County for the generation of electric power. These water rights were acquired by the California Power Company in 1901 and 1902 and since that time Southern California Edison has expended $881,104 in their development. The cost of the proposed new deevlopment is given as $4,118,205. The new development will be Kern River plant No. 3 and will involve a diversion dam 60 ft. high and 240 ft. long, of steel and concrete construction. Power will be developed by two turbines directly connected to generators of 15,000 kilowatts each, giving the new plant 30,000 kilowatts' initial capacity. The total fall to be utilized is 800 ft. and the amount of available power development is in excess of 54,000 horsepower. The new plant is to supplement existing plants of the company to meet the increased demand for electric current for light and power, and the company asks that it be given until July 1, 1922 to complete the work of construction.

TELEPHONE AND TELEGRAPH

FLAGSTAFF, ARIZ.—A private telephone line is to be installed here with connection with Prescott for the use of the Arizona Lumber & Timber Company.

OXNARD, CAL.—Rights of way are being secured by the Pacific Telephone & Telegraph Company for a new line the company is building from Los Angeles to El Rio.

WAPATO, WASH.—The city council has granted the Pacific Power & Light Company a franchise to furnish light and power to the town for a period of 50 years.

YUMA, ARIZ.—At a meeting of the board of governors of the Yuma County Water Users' Association, a resolution was passed having for its object the installation of an independent telephone exchange among unit holders of the valley.

HONOLULU, T. H.—Permanent improvements to cost $150,000 are being planned by the Mutual Telephone Company for 1917. They are an extension to the main plant on Adam's Lane and the installation of an automatic exchange in Kalihi, between $15,000 and $20,000 will be spent on the main building.

BENSON, ARIZ.—A telephone construction gang under the supervision of O. C. Joy is building a line between Benson and Bisbee via Fairbank. Besides the new Bisbee line there will be another extending from Fairbank into Tombstone and a branch line etxending into Huachuca and Hereford from a point about midway between Fairbank and Bisbee.

IRRIGATION

LOS ANGELES, CAL.—Lester H. Baxter of Independence has applied to the State Water Commission for permission to appropriate water of springs in Inyo County for the irrigation of 80 acres of land.

LOS ANGELES, CAL.—The Cardiff Irrigation District of Cardiff, San Diego County has applied for the use of one cubic foot average flow of Escondido Creek at Olivenhain for domestic and irrigation use. The water is to be obtained from three wells, 8 in. in diameter and from 56 to 61 ft. deep. To convey the water there is proposed a 22.418 ft. of 12 in. pipe, 3619 ft. of 8 in. pipe. The estimated cost, $84,200, and water to be used on tract of 825 acres.

ANDERSON VALLEY, CAL.—If all the plans of the directors of the Anderson-Cottonwood Irrigation District are carried out, there will be water running in the main canal of the irrigation system some time between June 15 and July 1. The completion of the construction of the system will be started within the next two weeks. There is more than enough land signed up, over $700,000, to call the election for a bond issue of $575,000.

LOS ANGELES, CAL.—J. G. Ruddle of Snelling has applied to the State Water Commission for permission to appropriate 20 cubic feet per second of the waters of Merced River in that county for irrigation purposes by a diverting dam the full width of the river. The applicant proposes to carry the water into a canal 6½ miles long. Two 12 in. pumps will lift the water 56 ft. to a point from which it will be carried by gravity, except in a few places where small auxiliary pumping plants will be used. It is intended to irrigate 1960 acres, the estimated cost being $10,000.

OAKDALE, CAL.—Three different storage propositions are being put into shape to be presented to the voters of the Oakdale Irrigation District. The Sierra and San Francisco Power Company offered to sell storage water for $1 per acre foot. J. H. Cameron and A. Roleri propose to dam the Stanislaus River near Copperopolis. The proposal is for a company to build the dam and sell it to the district taking bonds in payment. The third proposition is for the Utica Mining Company to build a reservoir at Spicers Meadow. This plan was previously held up.

SACRAMENTO, CAL.—The application to the Water Commission filed by W. E. Boone of Berkeley, who, it is understood, represents some of the principal irrigation corporations of the district, is planned to reorganize the entire territory under the name of the Kings River Conservation District, and to install an immense reservoir, as well as a number of dams and channels, at a cost of more than $9,500,000. Should the project go through, it will mean water for an area four times as great as is any under government reclamation system at this time. The plan calls for the damming of Kings River with a structure, plans for which have already been drawn. In addition to the construction of the reservoir, the development of the underground water supply is also contemplated.

ANDERSON, CAL.—Work on the completion of the Anderson-Cottonwood Irrigation project will proceed with a rapidity that will insure water to two-thirds of the district by the middle of summer. It has been decided to flume across Spring Gulch instead of completing the cut. It is estimated the completion of this work would require $25,000, whereas the flume it is declared will not cost over $18,000. A siphon across the Sacramento River to Churn Creek undoubtedly will be done away with provided the district can sell 110 tons of pipe it has on hand for this work. It is the intention of the engineers to bridge this crossing. The bridge will be of suspension character. Some $50,000 has been advanced the district by financial interests in San Francisco pending a bond election to be held this month.

LINDSAY, CAL.—The collective system of the Lindsay, Strathmore Irrigation ditch is 90 per cent completed, according to a statement of S. E. Keifer, engineer of the project. Twenty wells ranging in depth from 90 to 204 ft. have been completed, and with these the water supply will be sufficient to fill the ditches. At the end of the flume the water will be conveyed to the Strathmore district by means of a 36-inch pipe, and to El Mirador reservoir by means of a 30-inch pipe. From El Mirador reservoir the water will also be pumped to another high line ditch, which will supply a large acreage. The system requires the need of three power plants with a combined power of 3650 horsepower.

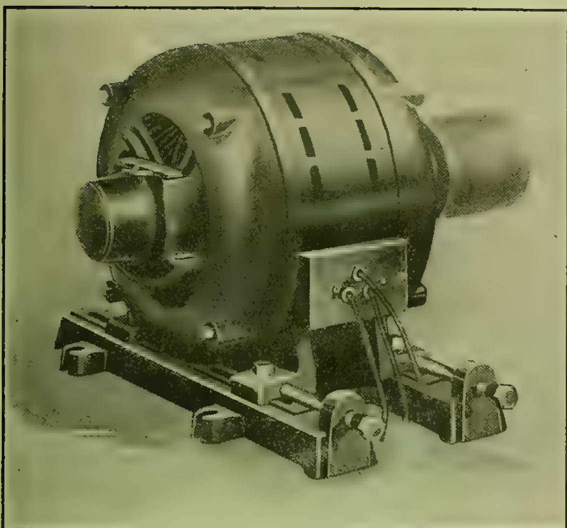
In This Issue *"The Electrical Supply Jobber: Is he a Nuisance or a Necessity?" together with Departmental Discussions of Vital Interest to Engineers throughout the West*

JOURNAL OF ELECTRICITY

VOL. XXXVIII No. 10 SAN FRANCISCO, MAY 15, 1917 PER COPY, 25 CENTS

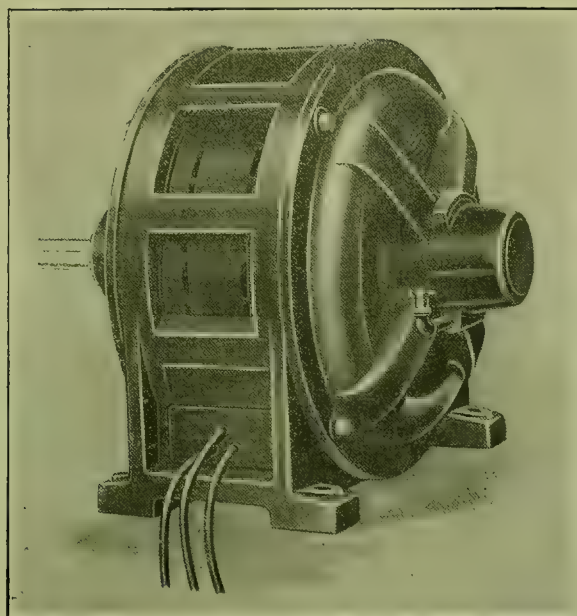
Howell Polyphase Motors

Equipped With Patented Rotor Re-Centering Bearings



5 H. P. 1800 R. P. M. Type "B" Riveted Frame Motor

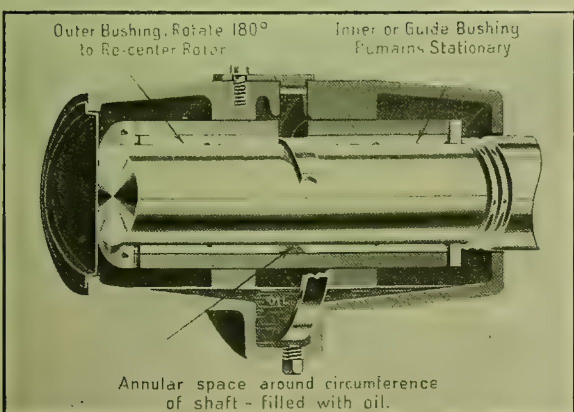
Cast end-rings; perfect mechanical and electrical joints, no throwing of solder



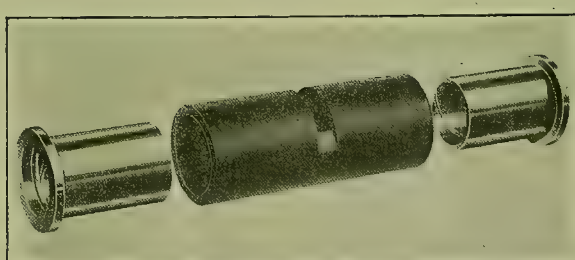
50 H. P. 1200 R. P. M. Type "A" Skeleton Frame Motor

Moisture and waterproof insulation on coils

Large bronze bushings; 100% over size



Assembled View of Bearing Showing Location in Housing. Inner and Outer Bushing Refers to Relative Position of Bushing in End Shield



Unassembled View of Bearing Showing Cylindrical Casing, also Inner and Outer Bushing

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HOWELL, MICHIGAN, U. S. A.

GARLAND-AFFOLTER ENGINEERING CO.

Western Distributors

SAN FRANCISCO LOS ANGELES

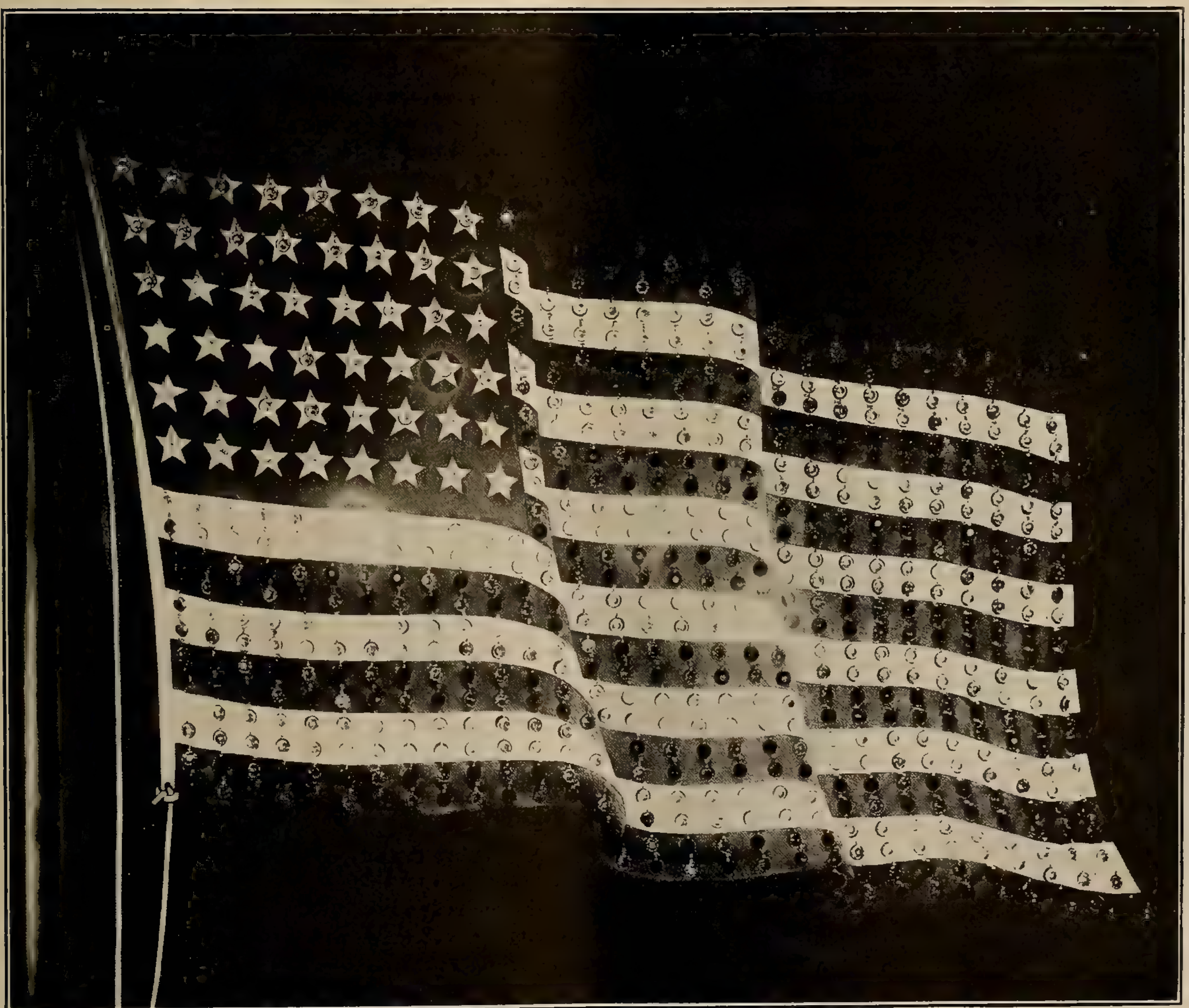
JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII | SAN FRANCISCO, MAY 15, 1917 | NUMBER 10

THE ELECTRIC FLAG AND THE NOVAGEM

(The flag, symbolic of all the purity and perfection which we as a nation hold dear and proudly sway to the breeze in order that all peoples may partake of the liberty and democracy that it represents in spiritual significance, is receiving the attention o noted illuminative experts in the study of brilliancy, hitherto unattempted. W. D'A. Ryan, the noted illumination engineer of the Panama-Pacific International Exposition, is producing effects by means of novagems set in the flag that either by sunlight or high powered searchlight bespeak an eloquence that stirs the innermost sentiments when beheld by the observer.—The Editor.)



The National Emblem Studded with Novagems

Those who attended the banquet at the Riverside convention of the Pacific Coast section of the National Electric Light Association will recall the flag of tantalizing beauty that was displayed during the evening's program in the rear of the toastmaster's seat. Its exquisite beauty and fascinating radiancy will long live in the minds of those who beheld it, so great an impression did this emblem make at that gathering.

The flag shown in the illustration is of a slightly larger design than the one exhibited at Riverside. The

hand cut novagems used are similar to the ones used on the Tower of Jewels at the Panama-Pacific International Exposition. They are suspended so that they may be moved by the wind and also the flag is perforated at each jewel in order that the flag may be effective when the sun hits it from the rear.

At night the effect of the throwing of light rays upon it from a high powered searchlight is difficult of description. Perhaps it may be best described as that flag which appears in consciousness when we endeavor to picture in mind all the nobility and sublimity that this emblem in reality symbolizes.

PROPOSED NEW ILLUMINATION EFFECTS

BY W. D'A. RYAN

(The West has ever played the leading role in evolution of artistic lighting design. In 1905 there was installed in Los Angeles the first ornamental electric street lighting system which consisted of a seven-light standard thirteen and one-half feet in height. This served to advertise Los Angeles the world over. Since then development has been rapid. Two new systems described below are proposed for Los Angeles and San Francisco by the author who is the well-known designer of the beautiful lighting effects for the Panama-Pacific International Exposition.—The Editor.)

Proposed Ornamental Luminous Arc Standard for Broadway Lighting Effect in Los Angeles

IN Los Angeles, it is proposed to use two designs of lighting standards alternating in pairs. This will add to the decorative feature and will furnish an additional element of advertising value. The designs are, respectively, the Rose standard and the Spanish Renaissance, both of which are particularly appropriate to Los Angeles. These were executed by Mr. J. W. Gosling, who has been associated with the writer for a number of years, and he also designed the major portion of the lighting standards and units used at the (San Francisco) Panama-Pacific International Exposition. The Los Angeles standards, without question, represent Mr. Gosling's best effort in this particular field.

The system recommended represents the most advanced practice in modern street illumination. The lighting will be lively without excessive intrinsic brilliancy. The arcs will be at an approximate elevation of 25 ft., where they will not interfere with the window lighting or sign lighting either by simultaneous contrast or otherwise, but will soften the general effect. They will add dignity and beauty to the streets by day as well as by night, and the apparent broadening of the streets and sidewalks as compared with the present effect of the globe cluster lights will be most marked. Not only will Los Angeles have a well lighted street surface, but owing to the high co-efficient of reflection of the buildings, the facade and sky line lighting will be unusual.

We have aimed to combine modern flood lighting and utilitarian results with a slight suggestion of the Carnival. The soft tone of the glassware specified, will be much less insistent than the present white glassware.

In San Francisco, the business section bounded by Market, Powell, Sutter and Kearny streets, with a block extension on Kearny, is to be known as the Triangle District.

Nearly nine thousand feet of streets are to be lighted in this district with approximately fifteen thousand feet of abutting property. There are to be a total of two hundred and fifty-six lamps. It is recommended that there shall be two 6.6 ampere luminous arc lamps on each standard. These lamps are to be equipped with San Francisco gold carrara glassware.

The definite design of the standard will be determined at a later date. For estimating purposes a suggested design is given which shows the distance to the arc to be 22 ft. This measurement should be maintained.

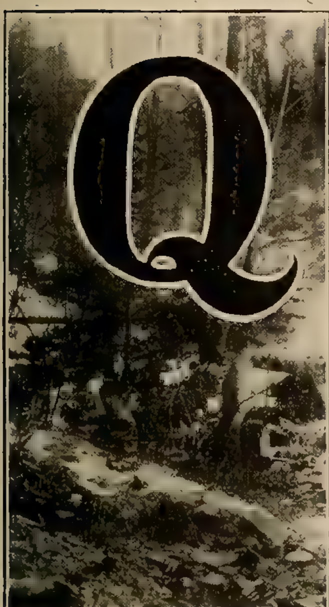
On the lighting plan certain locations are designated where lamps are to burn all night. All other lamps are to be extinguished at midnight. The present electrolier locations have been chosen in order to utilize the existing laterals. These laterals are one inch pipe and a special cable ⅞ in. in diameter.

Proposed Two-Light Ornamental Standard for San Francisco Triangle Business District

ECONOMIC DEVICES IN A SMALL HYDRAULIC SYSTEM

BY J. W. SWAREN

(Without the utilization of small hydraulic systems, little hope can be held out for ultimate complete development of latent water powers throughout the West, since such powers in the aggregate constitute gigantic totals in energy units. Here is a description of a small installation that should prove of unusual interest to readers of the Journal in that economizing devices are made use of in a small hydraulic installation that are proving useful and efficient, which augurs much for future extended development of small hydraulic systems. The author is a well-known hydraulic engineer with the Pelton Water Wheel Company.—The Editor.)



Stream at Low Flow with Small Dam for Diversion

QUINCY, California, a town of 500 people, has more than one hundred and sixty electric services, all metered, supplied by an hydroelectric plant on Ganser Creek, a stream with a water shed of three square miles; and a minimum flow of 1.25 sec. ft., extending over several months of summer and autumn.

Although an original installation had been made nearly eighteen years ago, the demand for service had been quiescent, as Quincy is a mining town of the days of hydraulicking. Advent of the railroad, with a large saw mill, and a transient influx during the vacation season, brought about load demands beyond the capacity of the old, belted type generator driven by a hand-governed Pelton wheel.

Rumors of competition were heard. The lines of one of the large transmission companies were only 22 miles away. The Christmas peak of 1914 and summer peak of 1915 reached a value rendering prompt relief imperative, and a general condition existed that would influence the public service commission to look with favor on a competitive application.

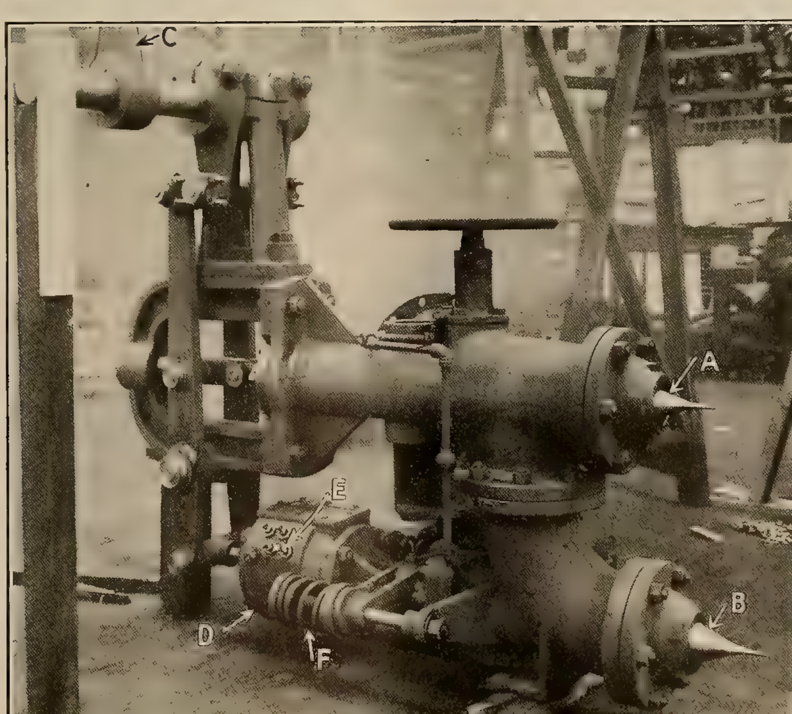
While there are a number of water power sites available within a few miles of Quincy, careful investigations indicated the advantage of utilizing Ganser Creek, the stream already in use. This permitted the station to be built just across the street from the residence of H. C. Fluornoy, manager of the Quincy Light & Power Company, and less than half a mile from the load center of the system. Further, the entire water shed of Ganser Creek is owned by the company, while development of any other site would involve purchase from other holders, or permits from the Forest Service.

Small Storage Reservoir Provided 24 Hour Service

At no time does this stream have an excessive flow, as all the slopes of its drainage area are heavily forested. During the summer and early autumn, before the fall rains, and again in early winter, when frost checks the stream flow, the water quantity is very low, some years dropping to 1.25 sec. ft. A brush and gravel dam diverts the entire flow during low water, through a measuring box into a ditch, 300 ft. long, leading to a reservoir with a capacity of 90,000 cu. ft. The dam, stream at low flow, and measuring box are shown in the first illustration.

The reservoir was built by excavating into the canyon bank, with team and scraper, moving the dirt into a dam, 300 ft. long and 16 ft. high at its highest point. The earth was thoroughly packed by the teams, which were driven the full length of the fill, and care was taken to exclude all leaves and sticks. A slope of 2½ to 1 was maintained on the inside, and 1½ to 1 on the outside. This reservoir has been in use several years. No trouble has been experienced with silting, but falling leaves from the surrounding heavy stand of timber have proven a severe annoyance, and it has been found necessary to clean the bottom at least every two years.

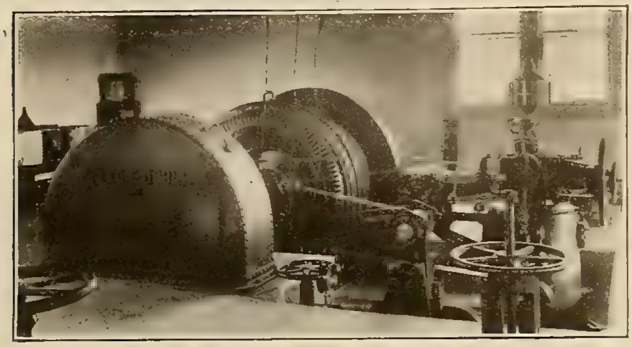
By storing surplus flow during daylight and early morning hours, sufficient water was provided



Water Economizing Relief Nozzle

for carrying the old plant over peak loads. When the new installation was contemplated, additional storage was desired. However, careful examination of the canyon proved that no site was available where a storage dam could be built at a cost justified by increased revenue.

Some consideration was given to a plan of increasing the capacity of the present reservoir slightly, and pumping the flow of a large group of springs bursting out a little lower than the reservoir, and on the opposite side of the canyon. This was planned to utilize power developed by normal stream flow during off peak hours. While the difference in heads permitted a considerable saving of hydraulic energy, this plan was abandoned because of the expense of building and maintaining a line through heavy timber, the expense of installing a suitable pumping equipment, and its operation.


Pelton Water Wheel of 140 h.p. with Economizing Devices

Water Economizers for Unusual Conditions

A careful analysis of the possibilities of the minimum stream flow, combined with the small storage available, when utilized by a high efficiency water wheel fitted with specially developed economizing devices, indicated that not only could twenty-four hour service be maintained, but that a peak load of 80 kw. could be carried.

The penstock leading directly from the reservoir is 5100 ft. long, tapering from 22 in. at the reservoir to 10 in. at the power house, where a static head of 360 ft. is available. The power house, Fig. 4, is a concrete block building 38 ft. by 32 ft.

The old water wheel is still in place, to be used in case of an accident to the new unit. But entire operating reliance is placed on a new unit, as shown in the illustration, installed early in 1916. This is a Pelton wheel, rated at 140 h.p., direct connected to a General Electric 3-phase 2300-volt generator rated at 80 kw. at 80 per cent p.f. The water wheel is of the overhung type, with the exciter belt driven from a pulley on the main shaft. A two-panel switchboard controls the electric equipment, a Tirril regulator maintaining proper voltage regulation.

Chief interest centers on the water-economizing devices of the water wheel. These consist of an auxiliary relief nozzle system, actuated by a Pelton self-contained oil pressure governor. The nozzles, without the governor, erected on the factory floor before shipment are shown in the second illustration. The main or power nozzle, the jet of which impinges on the wheel buckets, is at A, while the relief nozzle, the jet of which passes into the tailrace without striking the buckets, is at B, and by-passes the regulating water.

The governor, attached at C, actuates both needles, through a link system, the relative direction of movement being opposite. The main needle is directly linked to the governor system, while the relief needle is connected through the cataract compounding system shown at D. The link of the cataract is connected to a piston moving in an oil-filled cylinder. The rate of motion of this piston is controlled by compounding valves adjusted by the stems projecting at E. The cylinder is rigidly connected to the needle stems, and the coil springs at F, are compressed when the lower needle is retracted, a return of the relief needle to a complete closure being the normal function. The areas of these nozzles have a definite relation and the arms of the operating lever are so proportioned that with the compounding valves set at zero, any variation in the nozzle opening of the main or power nozzle, will be accompanied by a corresponding change, in the opposite direction, of the relief nozzle, and a constant flow is maintained through the penstock, no water economy being effected.

With the valves set for full compounding, the piston will have unimpeded motion, and the relief nozzle will not open under any load change, thus limiting the flow in the penstock to the water actually required for the load. Because of the inelasticity of the water column, this condition could only be obtained with a penstock of unusual characteristics. However, as any relative motion between the two


The Power House for the Quincy Installation

needles that may be desirable, can be obtained by proper adjustment of the compounding devices, it is easily possible to secure a relation permitting high water economy, close speed regulation, and penstock surge pressures not exceeding permissible operating limits. This unit has been in operation for several months, including the holiday peak, and the twenty-four hour water consumption has been kept at a point sufficiently low to permit of entirely satisfactory service. All talk of competition has been abandoned, and the company, with excess power at its disposal, is planning an active appliance campaign. A large vacation population makes appliances good revenue producers.

The data from which this article was prepared was obtained while making an inspection in the interests of the Pelton Water Wheel Company, contractors for the water wheel equipment. The analysis of hydraulic conditions and the general design of the plant were under the direction of Sydney Sprout, consulting engineer.

THE JOBBER: IS HE A NUISANCE OR A NECESSITY?

BY A. T. SLACK

(The electrical supply jobber is a creature of comparatively recent origin. Here is an article by an author who is connected with the Denver branch of the Western Electric Company. This article deals in a masterly manner with the real worth and scope of activity of the electrical supply jobber. It should receive the serious attention of all men interested in the electrical industry throughout the West where conditions are unusually well-adapted to increased efficiency of electrical supply brought about by the advent of the modern, electrical jobber. The paper was delivered before the recent convention of the New Mexico Electrical Association.—The Editor.)

In presenting to your association the question, "Is the Electrical Supply Jobber a Nuisance?" I did so not for the purpose of attempting to be frivolous or humorous, but to draw your attention to the fact there can be no middle ground, and unless the jobber can justify his existence as a necessity to the business, he is nothing more nor less than a nuisance and should be abolished.

The visiting salesman and advertising matter inflicted upon the central station man and our other customers are clearly a nuisance unless they prove themselves of value to him, and if they, as the representatives of the various jobbing interests, are of value, then it must necessarily follow that the jobber and his business are also of value, and he has a legitimate and necessary place in the great business in which we are all so highly interested.

Going back for a moment to the earlier days, I recall very distinctly the condition of the business at that time when this question might have been a proper one, and subject to fair and serious argument. Then the business as a whole was so small that the jobber could not justify his existence by the value which he rendered to the balance of the trade. At that time the company I have the honor to represent embraced within its business the four great divisions we find today, namely: the manufacturers, the jobber, the contractor and the central station.

It may interest you to know that the Western Electric Company was one of the pioneers in the central station business in Chicago, and their central station plants were finally sold to what is now the Commonwealth Edison Company. The rate at that time was fifty cents for each arc light per night, with the lights burning from dusk to midnight. Comparing these rates and character of service with what you gentlemen are prepared to furnish the public today through the Type "C" or nitrogen lamp, we can look back along the pathway of progress and see clearly and distinctly the advancement made in the central station business.

The manufacturers can present an equally, if not an even more brilliant pathway leading back to that humble beginning; the electrical contractor has kept step to the music, and though possibly some of you may doubt it, let me assure you the jobber has also grown and kept pace with his comrades in the line until he has proven he is not a nuisance, but an absolute necessity to you in your end of the business, just as much so as the manufacturer who builds the machinery by which you operate your plant.

First of all, let me explain to you definitely what I mean by a jobber. The electrical supply jobber is entitled to this name and to this distinction only when through the means of an up-to-date catalog and traveling salesman he can bring to you and to your place of business, at the least possible cost and expense to you, any or all of the various kinds of apparatus and supplies necessary for the building and the operation of your plant. His business is to secure from the various manufacturers all of these different kinds of apparatus and supplies, accumulate them in storerooms as conveniently located to your plant as business conditions will permit and be prepared to furnish you whatever you may choose from this vast accumulation, so that your requirements may be served promptly with no more trouble than it takes to turn to a page in a catalog and properly describe what you want.

For this service of accumulating and distributing the supplies you require, he is entitled to compensation in the nature of a reasonable profit on the goods he sells. This profit should be sufficient to meet his expenses and give him a return on the money he has invested in the business commensurate with the risk he must necessarily assume in conducting that business; and let me assure you gentlemen, his revenue and his expense cannot be foretold from month to month quite as readily as the revenue and the expenses of a public service property, with which you are more familiar.

He has confronting him the question of seasons for such supplies as fan motors, heating appliances, etc.; building conditions upon which so much depends for his contractors trade, sleet storms, cyclones and other disturbing elements of nature which play havoc with the lines, and oftentimes his men are called out at all hours to get the necessary material to you by first train so that your service may be restored in the shortest possible time.

There is attached to the jobbing business, as I have intimated, the element which you can understand best as "readiness to serve," exactly the same as in the central station business, but unfortunately we haven't found a way to satisfactorily present to our customers a minimum charge each month for this service which would meet with their approval and which we would be able to collect; nevertheless I believe the jobber, by keeping himself in a position to assist you in the immediate restoration of your service in case of disaster, is of value to you exactly as insurance has its value, although you may never have the misfortune of a fire, nor the opportunity to recover through a loss any of the premiums you may have paid.

Coming down more specifically to the direct question, "Is the Electrical Supply Jobber a Necessity?" the answer must be emphatically, yes.

Take the company I represent if you will, as a representative supply house; we had on January first, this year, in stock available for the trade, a little over eighty-seven hundred different kinds of apparatus and supplies likely to be called for, and which we consider

necessary to carry. The one line of wiring devices manufactured by the Bryant-Perkins Company alone, consists of about four hundred and fifty different kinds of articles; the additional lines are procured from about one hundred and forty different manufacturers.

Now, assuming, if you will, that we and all of the other jobbers should decide to abandon our business, would it not mean that instead of looking to one source of supply for these eighty-seven hundred various articles, you would, without question, have to deal with each of these one hundred and forty various manufacturers? Does it not mean that instead of depending upon over-night service you would have to adjust yourself to over-week service, or over-month service and increase your stock and investment accordingly? Does it not mean also, instead of dealing with the salesman representing the supply house, and from what I am led to believe they are numerous enough, you might be afflicted with an army of salesmen, each trying to make you believe the particular line he represents was the only one to buy? These are not exaggerated conditions likely to occur, but would certainly arise.

Neither do I believe the day is here when the electrical supply business can be handled as a mail order business; its progress is too rapid and its elements too technical to depend upon correspondence for success. Every successful contractor and every successful central station man wants to be abreast of the times, and I submit this can be done with the most certainty and most economically by personal contact between the buyer and the seller. Your association and this very meeting is the best evidence of your belief in this matter of personality.

As I stated in the beginning, an electrical supply jobber to be entitled to this name and position in the business must publish a catalog. That these catalogs are of value to you is best demonstrated by the fact that you will find them on the desk of every purchaser in the business, not because they are ornamental but because they are valuable. Instead of a few condensed, well compiled catalogs, assume it was necessary for you to have a separate catalog of each of the one hundred and forty manufacturers to whom I have referred when you wished information; and it should be remembered also, that as a rule the jobber sells a line of but one manufacturer, and as each line has, I am sure, an average of, at least, five different manufacturers, instead of one hundred and forty catalogs you would be more likely to have some five or six hundred to consult or destroy, as your office space permitted—would such a condition make you long for a jobber's catalog with which you are familiar? I believe it would.

These few but unmistakable ways I have attempted to bring to your attention, are not the only ways in which the jobber has justified his position in the business; he is doing his share in the field of co-operative work, and in the great work planned by the Society for Electrical Development; he has assumed his share of the burden and his share of the work to make good the slogan "Do It Electrically," and a word or two regarding its work may not be amiss.

A few years ago some of the biggest men and brightest minds in the business conceived the idea that, first of all, the four great divisions of the business had their respective fields with distinct and natural boundaries and limitations:

First comes the manufacturer, whose aim it is to develop and manufacture the apparatus and supplies required in the business.

Second comes the jobber who, as I have attempted to point out, accumulates all of these various kinds of apparatus and supplies from the various places at which they are manufactured and concentrates them in a place convenient to their ultimate use.

Third follows the contractor, whose job it is to take the apparatus and supplies as delivered to him by the jobber, and place them in their permanent position ready for the current furnished by you gentlemen.

And finally comes the central station with their job practically limited to making the connection and collecting their revenue.

You may also have overlooked the interesting fact that the first three men receive only one profit on their sales, and a most moderate one at that, while the revenue or profit of the central station man continues on forever or, as long as he operates his plant.

As I have said, the men who conceived this Society for Electrical Development saw these respective fields distinctly, and more than that, they saw the tremendous amount of money spent each year in advertising to secure the business that had already been created by wresting it from each other, and they realized and believed that if a part of this vast sum was used to create a new demand, thus creating new and additional business for the manufacturer; that not only he, but the jobber, contractor and central station man as well, would all profit by the new demand, and they believed also this new demand could best be created through the joint efforts and the joint resources of the entire industry. The result was, as you know, the larger interests pledged their support and have endeavored to have others do likewise.

The sum of two hundred thousand ($200,000) dollars per annum has been pledged, and the society has just started on their campaign to instill into the minds of the public that the way to do things is to "Do It Electrically," and some of the tangible results are already beginning to reach the members.

Perhaps you have noticed, that a great many contractors' windows, and this applies, to a large extent, to the central station display windows as well, look more like a work bench than an effort to induce people to buy goods; the society is studying out the best methods to display the goods offered for sale. This however does not apply to the central station and contractors in Albuquerque.

Instead of being the best lighted and most tastefully decorated windows in town, I have found electric shops which came closer to being the worst. If the contractor, or central station man, is indifferent to his window lighting and display, how can he expect his neighbors to take any interest and furnish him any business?

Not only the Society for Electrical Development, but all the first-class jobbers and manufacturers through the jobbers, recognize this deficiency and are furnishing for display purposes all kinds of attractive

advertising matter and instructions how to display it, absolutely free of cost to those requiring it.

I would also like to call your attention to the fact that the most advanced jobbers today are spending their efforts, not so much to sell the goods to the central station, contractor and dealer, but rather to help and educate him to see that the goods are sold to the ultimate consumer.

This society is endeavoring to have the settings of moving pictures brought up to date by showing the use of electrical apparatus and household appliances; in one instance where a picture showed an accident due to the use of electrical current, they have had this part of the film changed.

The company which I represent has for the past year furnished a 1000 ft. film called "Drudge," leading up from the old household drudgery to the present modern electrical appliances of today which we are glad to supply to the central station men at any time wanted.

The advertising campaign of the National Electric Lamp Association with which you are more or less familiar, is a fine example of what co-operative advertising and creative sales work can accomplish at a minimum expense to all.

I could go on at length showing what is being done and contemplated, but I shall have to leave this to the printed reports sent to each member monthly, and if you have not received a copy let us know and we will see you are supplied.

While, as I have said, I have endeavored to show that there is a well recognized line between the service the manufacturer and jobber render to the electrical industry as a whole, I realize that sometimes you are confronted with the opportunity to buy your supplies direct from the manufacturer, or through a jobber, at exactly the same price; the question then is, which one should be favored with the business, and different men look upon the proper answer from different points of view.

Laying aside entirely the question of personality, it is clear that the business should go to the one from whom the purchaser will secure the most value for his money; prices and articles being the same, it is equally clear this additional value must come through some indirect return, usually service.

I hope you will all agree with me that the concession the jobber secures from the manufacturer in the more favorable price, due to the greater opportunity he has for disposing of the goods, and which enables him to sell to the consumer on an equal basis, is a legitimate concession and one he is justly entitled to, because it simply follows one of the fundamental rules of business that, the greater the purchasing power the more favorable prices it commands.

Some purchasers, but I am glad to say they are in the minority, have taken the position that, by favoring the manufacturer direct on an even price basis they are advancing their own interests. As near as I can ascertain, their theory is, that by doing so they are more likely to secure the same price as the jobber on their next purchase. I sincerely believe however, this is a mistaken idea, and that just as long as the jobber holds the greater buying power just that long the manufacturer will find it to his interest to sell him at a more favorable price.

It seems clear to me however, there can be no question as to what attitude you should take when these conditions confront you; the jobber is entitled to your business on an even break for the service he is in position to render you, and you are serving your own interest best by seeing that he gets it.

There is another element of relationship with the jobber that should not be overlooked. The fundamental basis of his relation with you is service, but it is accompanied by that other important element of quality. You will find invariably the better class of jobbers do business on the basis of quality and service first; that is, they determine the cost of their merchandise and add to that, the cost of satisfactory service to you and a reasonable profit to themselves, and then fix their selling price to you accordingly. Thus, as I have said, let the cost of their merchandise and doing business control their prices. On the other hand, you have people attempting to sell you goods in competition with the jobbers, whose business is based on price first and the quality of goods and the service rendered is controlled absolutely by what they can afford to give for the price they have been able to obtain.

The question of which of such policies it is to your advantage to accept, could be answered readily and to a certainty if the price you paid the supplier was the cost to you of the goods that have been purchased, but unfortunately the cost of merchandise does not cease when the bill is paid to the supplier. This distinction of price and cost is one too often and too readily overlooked by the average buyer. The price is always certain and readily ascertained, it is limited invariably to the amount of cash you pay for the purchase and nothing more, but this by no means is the cost of the goods. If the purchase is made for resale the cost cannot be ascertained until the goods have been sold and the money collected, and even at this period you are not entirely safe in assuming that the additional costs added to the price have all been taken care of, as no doubt the goods you sell carry with them a guaranty, either expressed or implied, and the cost of making good on these guarantees must be added to the price paid the supplier.

This same element, but to a much greater extent, exists in the purchases made for use and operation. In such cases, to the original price paid must be added the cost of maintenance, and comparative costs of operation and the comparative life of the particular article or piece of apparatus in question; and here again, you cannot determine your definite cost until final disposition is made to the junk dealer, or until it is otherwise disposed of.

The careful, far-sighted purchaser never fails to keep before him this distinction between price and cost, and, as I have said, the best supply jobbers sell only that class of merchandise and render such service, that the difference between the price they charge and the ultimate cost to the purchaser is narrowed down to the smallest possible margin.

Now gentlemen, I hope I have shown you good cause to believe the electrical supply jobber is not a nuisance but a necessity, and as a necessity I am

going to appeal to you to see that this necessity is recognized and appreciated in the broadest possible way.

The business of the jobber in accumulating and distributing the products you require is a comprehensive and an expensive business to conduct and he is entitled to a fair return for his services.

Mr. Franklin Overbaugh, general secretary of the Electrical Supply Jobbers' Association, advises me that as far as he can ascertain, the records show the average bill of the jobber is about twenty ($20.00) dollars for each shipment. What his net profit is I will not attempt to say, as this depends entirely upon his efficiency as a business man; but I believe you will have to think hard and long to recall any man engaged in the jobbing business who has accumulated a sufficient fortune to enable him to retire and live off the interest on his money.

As I have attempted to point out, the jobbers have endeavored to do their part to have this country occupy the proud position it holds today as the foremost in the world, not only in its great electrical industries, but in the wide-spread use of electricity as well.

I hope I have convinced you gentlemen that the electrical supply jobber is not only a necessity but also, that his success means your success, and that you should continue to give him, not only encouragement, but your unlimited support, so that he can make himself even more valuable to you than he has in the past.

It is a known fact that some of the largest manufacturers in the country today are refusing to ship or build direct to the trade, preferring that their business be handled through the jobber. That I think in itself conclusively shows that the electrical jobber is absolutely a necessity.

THE DISASTER AT THE MOUNTAIN KING MINE

A recent disaster happened at the Mountain King Mine on the Merced River in California. The mine derives its power from its own hydroelectric plant, diverting the flow from the Merced River through about a mile of flume. At a point close to the power house there was a leak started in the flume due to the checking in the seasoning of stringer timbers. This was not serious but in order not to interfere with the operation of the plant a temporary repair had been made until such time as the plant could be shut down for a few hours to make the repair permanent.

On the morning of the day of the accident the point in the flume under repair began to give trouble and the plant was shut down and the water turned out so that the slopping over would not wash away the hillside below the flume. This caused the air-compressor at the mine to shut down before the smoke and gas in the winze could be blown out.

It is alleged that notice was served upon men not to enter the workings during the period of shut down. Certain of the men entered, however, and were as a consequence overcome by the gas. The hydroelectric plant meanwhile was put back again into service during the day of the accident after the three or four troublesome sections of fluming were repaired.

LETTER TO THE EDITOR ON THE NATIONAL CRISIS

Sir:

In this great time, when every citizen must do his part, the President has made his chief appeal to the men who live on the land. He is right in doing so, for the safety of our country just now is in the hands of our farmers. What I mean is not merely our safety and the safety of our allies in the matter of food. I mean that the safety of the United States against foreign invasion hangs on the decision of the farmers of the forty-eight states.

The two great weapons in this war are arms and starvation. The war against German arms will be won or lost in France—the war against starvation will be won or lost in America. The Kaiser cannot whip the French and English armies and the English navy while England has food. But it is still possible that the German submarines may be able to keep food enough from reaching England to starve her into submission.

If the submarines win, the first item in the Kaiser's terms of peace will be the English fleet. With the English fleet in his possession, the Kaiser will be master of the world.

What will happen to us then? Every man who stops to think knows the answer. We shall have money, food, labor, land,—everything that is desirable in the world except the power to protect what we have. Experts estimate that it will take us nine months to get ready to meet a German army of 150,000 men, with modern artillery. Under such circumstances, would the Germans treat us better than they already treated Belgium and France?

Even if the armies of our allies should crush the German military power this summer, before the shortage of food can reach the point of want, the world would still need vast quantities of American food. But if they do not, only one course can make us safe, and that is to grow food enough on our farms for ourselves and our allies, and to put ships enough on the sea to carry the food, in spite of the submarines, to the men who are fighting our fight.

If the war lasts beyond this summer, it will be the American farmer who will win or lose the war, who will overcome militarism and autocracy, or allow them to spread and control the world, ourselves included.

This is no fanciful picture, but sober fact. Many a man will make light of it until he comes to think it over, but I venture to say that few will treat it lightly after careful thought. It is no more impossible than the great war itself appeared to be, only a few days before it began.

It is true that we can greatly increase the available food supply out of grain now used in making liquors, and by reducing household waste. But when these two things are done, and done thoroughly, they will not be enough. The final decision will still rest in the hands of the men who raise our food in the first place.

The clear duty of the Nation is to guarantee the farmers a fair price for their crops when grown, and a reasonable supply of labor at harvest. The clear duty of the farmer is to raise food enough to win this war for democracy against Kaiserism.

No such responsibility has ever rested on any class of men since the world began as rests today on the farmers of America.

Sincerely yours,

GIFFORD PINCHOT.

On parts of the Angeles National Forest in California the packrats are so abundant that many of the young pines planted by the Forest Service have been killed or injured by the rodents. The damage seems to take place chiefly in the late summer and fall and is more extensive in dry than in wet seasons. It is thought that the rats tear off the tender bark of the trees to obtain moisture at times when water is scarce.

HYPERBOLIC SOLUTION FOR ENGINEERING PROBLEMS

BY W. D. PEASLEE

(Transmission line phenomena are intricately associated with hyperbolic functions when any mathematical representation or analysis is attempted by the engineer. Here is a discussion that should enable engineers not previously familiar with the subject to obtain a workable use of this valuable form of analysis, and, again, it is believed that a thorough mastication of the discussion set forth will arouse some to further study of the subject. The author is in the department of electrical engineering at the Oregon Agricultural College, and is a well-known consulting engineer of Portland, Oregon.—The Editor.)

In the investigation of engineering problems mathematics of one degree or another is the universal means of correlating the given conditions of a case into terms of effect or in other words into operation, and a great many engineers solve problems by very laborious methods through their ignorance of the existence of a better easier method. Higher mathematics are in general merely short cuts and the higher the mathematics the shorter the cut, and as such they should be the tool of engineers to a much greater extent than they are today.

This article is not intended in any way as a complete exposition of the subject nor as an original discussion as all the formulae used have been developed by many other workers and may be found completely in the brief bibliography at the end. Some of the problems have been taken in part from various texts and the charts used have been developed by at least Fleming and Kennelly. It is however unfortunately true that these charts as well as the methods of use of Hyperbolic Functions are unknown to many engineers and this fact is the only excuse offered for their presentation.

It is hoped that two results may be realized by the presentation of this article; first that it may give to engineers not previously familiar with the subject, a workable use of certain of its most valuable equations and second, that it may arouse some to a further study of the subject, and to that end a brief bibliography is appended.

First the application of Hyperbolic Functions to the solution of a transmission line problem will be taken up and later brief mention will be made of some other branches of engineering work wherein they may be used to great advantage.

Anyone who has attempted an extended investigation of the variation of the voltage and current in a transmission line in terms of distance from the receiving or sending end will realize the vast amount of actual mathematical manipulation involved and to

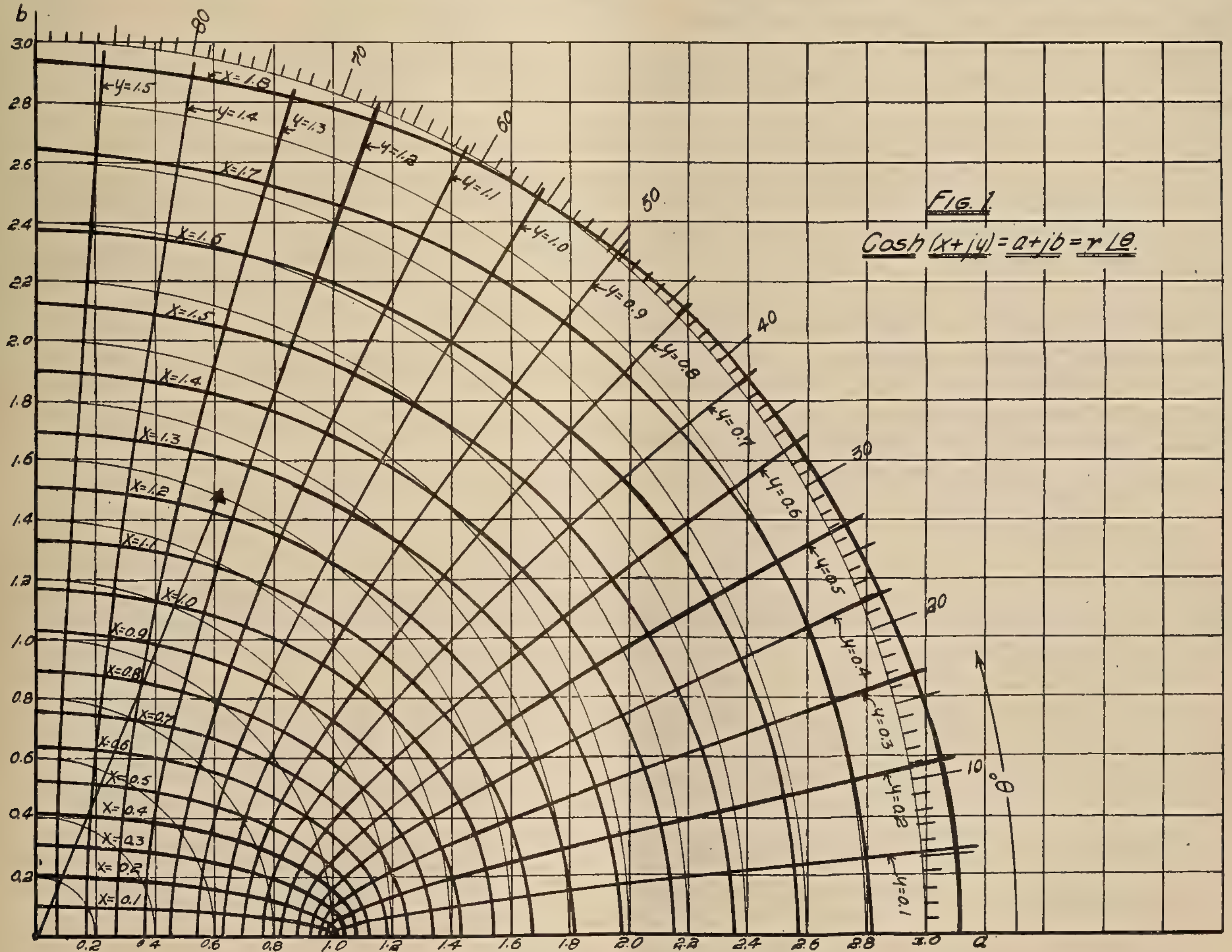


Fig. 1. A Graphic Chart of the Hyperbolic Cosine

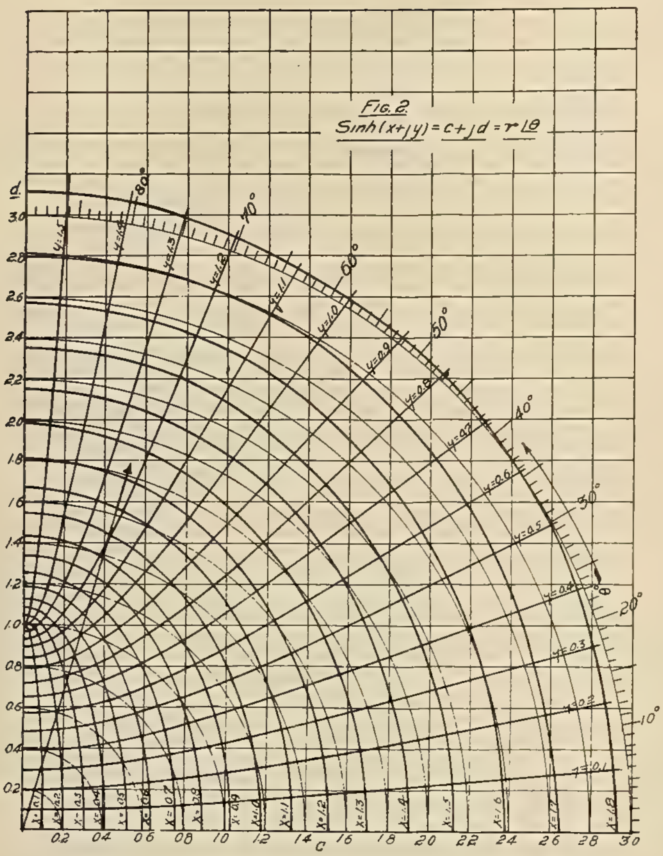


Fig. 2. A Graphic Chart of the Hyperbolic Sine

them the simplicity of the solution by means of Hyperbolic Functions will be a distinct revelation.

The common method of solution involves the equations,

$$(1)\quad E_1 = E_0\left(1 + \frac{ZY}{2}\right) + ZI_0\left(1 + \frac{ZY}{6}\right) + \cdots$$

$$(2)\quad I_1 = I_0\left(1 + \frac{ZY}{2}\right) + YE_0\left(1 + \frac{ZY}{6}\right) + \cdots$$

using only the terms indicated as the series is so rapidly convergent. In these equations,

E_1 = the voltage at any point.
I_1 = the current at that point.
E_0 = the voltage at the receiving end if the sign is + and at the generating end if it is —.
I_0 = the current corresponding to E_0.
$Y = (g + jb)$ to neutral.
$Z = (r + jx)$ to neutral.

If investigating the variation of E and I with respect to distance along the line a separate solution of these equations is necessary for each point and the solution becomes very tedious.

The necessary equations for the solution of this problem by means of Hyperbolic Functions will now be developed from the fundamental relations of the electric circuit and an assumed problem will be solved by their aid.

Let,

R = resistance of conductor in ohms per mile.
L = the coefficient of self induction in henries per mile.
C = the capacitance in farads per mile.
G = the coefficient of leakage in ohms per mile.

It may be shown[1], that if any simple harmonic function $a \sin(wt + \theta)$ be represented by a vector of length a and angle θ then two simple harmonics of the same period $2\pi/w$ but having different values of phase angle θ can be combined by adding their representative vectors.

The voltage and current at any point of a circuit distant x from the receiving end are expressed by the equations,

(3) $e = e_0 \sin(wt + \theta)$
(4) $i = i_0 \sin(wt + \theta')$

wherein e, i, θ, and θ' are all functions of x.

The relations between e and i are expressed[2] by the equations,

[2]Loc. Cit. p. 181.

(5) $di/dx = Ge + C\, de/dt.$
(6) $de/dx = Ri + L\, di/dt.$

Now $de/dt = we_1 \cos(wt + \theta) = we_1 \sin(wt + \theta + \pi/2)$ so de/dt will be represented by the vector $we_1/\underline{\theta + \pi/2}$ and di/dx will be represented by the sum of vectors $Ge_1/\underline{\theta}$ and $Cwe_1/\underline{\theta + \pi/2}$, whose numerical magnitudes are Ge and $jwC\bar{e}$. By similar reasoning for de/dx in equation (6) we have,

(7) $d\bar{i}/dx = (G + jwC)\,\bar{e}.$
(8) $d\bar{i}/dx = (R + jwL)\,\bar{i}.$

which are equations that do not involve time derivatives.

Differentiating these equations with respect to x we have,

(9) $d^2\bar{i}/dx^2 = (G + jwC)\, d\bar{e}/dx.$
(10) $d^2\bar{e}/dx^2 = (R + jwL)\, d\bar{i}/dx.$

Substituting from (7) and (8) the values of $d\bar{i}/dx$ and $d\bar{e}/dx$

(11) $d^2\bar{e}/dx^2 = (R + jwL)(G + jwC)\,\bar{e}.$
(12) $d^2\bar{i}/dx^2 = (G + jwC)(R + jwL)\,\bar{i}.$

from which we find that $\bar{e}$ and $\bar{i}$ are similar functions of x.

Now for mathematical convenience the reasons for which will not be discussed here we will employ two constants,

$$m = \sqrt{(R + jwL)(G + jwC)}.$$

$$m_1 = \frac{m}{G + jwC}$$

and we may then write the equations

$d^2\bar{e}/dx^2 = m^2\bar{e}.$
$d^2\bar{i}/dx^2 = m^2\bar{i}.$

The solutions of these differential equations are simple and space will not be taken here for the details which can be consulted in any standard work on differential equations.

The solutions are,

(13) $\bar{e} = A \cosh mx + B \sinh mx.$
(14) $\bar{i} = A' \cosh mx + B' \sinh mx.$

Now substituting in equation (7) we have

$d\,(A' \cosh mx + B' \sinh mx)\,/dx =$
$(G + jwC)\,(A \cosh mx + B \sinh mx),$
$mA' \sinh mx + mB' \cosh mx =$
$(G + jwC)\,(A \cosh mx + B \sinh mx).$

and equating coefficients,

[1]Bedell and Crehore, Alternating Currents, page 214.

$mA' = (G + jwC)\ B$ and $mB' = (G + jwC)\ A$ from which $A' = B/m_1$ and $B' = A/m_1$, so we find that only two of the constants in (13) and (14) are arbitrary.

Now establishing the following conventions,

E = receiver voltage.

I = receiver current.

e_x = voltage at any point distant x from receiver.

i_x = current at any point distant x from receiver.

and putting $x = O$ we have

$E = A.$

$I = A'$ from which we have

$B = m_1 I.$

$B' = E/m_1$, and equations (13) and (14) then become,

(15) $e_x = E \cosh mx + m_1 I \sinh mx.$

(16) $i_x = I \cosh mx + E/m_1 \sinh mx.$

It can be easily shown that if we consider E and I as the voltage and current at the generator end and measure x from that end these equations become

(17) $e_x = E \cosh mx - m_1 I \sinh mx.$

(18) $i_x = I \cosh mx - E/m_1 \sinh mx.$

Equations (15) and (16) are very interesting as they express the current and voltage of the line in the no load and load components as will be seen if we let $I = O$ we have as the charging current $i_c = E/m_1 \sinh mx.$

The load current then is represented by the expression, $i_L = I \cosh mx.$

Likewise for the voltage equation we find that,

$E \cosh mx$ = the line voltage influenced by the charging current and, $m_1 I \sinh mx$ = the line drop due to the load current.

It will be seen however that m and m_1 are complex quantities of the form $a + jb$ and in order to make use of these equations tables of cosh $(x + jy)$ and sinh $(x + jy)$ must be available, or these quantities must be computed, which would make the use of these functions as laborious as any other method of computation. Several very good tables are available and are listed in the bibliography.

An assumed transmission line problem will now be solved by means of these equations.

Given:

Length of line: 500 miles.

Conductor: Aluminum cable, steel core, 1.25" dia. 800,000 cm. of aluminum.

Spacing: 30 ft., triangular.

Three phase, 60 cycles.

Receiver conditions: Load 150,000 kw., 85% P.F. lagging. Voltage 250,000 (144,000 to neutral)

Problem: Find the voltage and current relations for all parts of the line under full and no load operation.

$r = 0.1127$ ohms per mile.

$$C = \frac{89.4 \times 10^{-9}}{\text{Cosh}^{-1} D/d} = 14.08 \times 10^{-9} \text{ farads per mile.}$$

$jwC = j2\pi\, 60C = 5.31 \times 10^{-6}.$

$jwL = jx = j2\pi\, 60L = j2\pi\, 60 \times 5.28\ (1.41 \log_{10} D/d + .576)\ 10^{-4}.$

$jwl = j.803$ ohms per mile.

$r + jx = .1127 + j.803.$

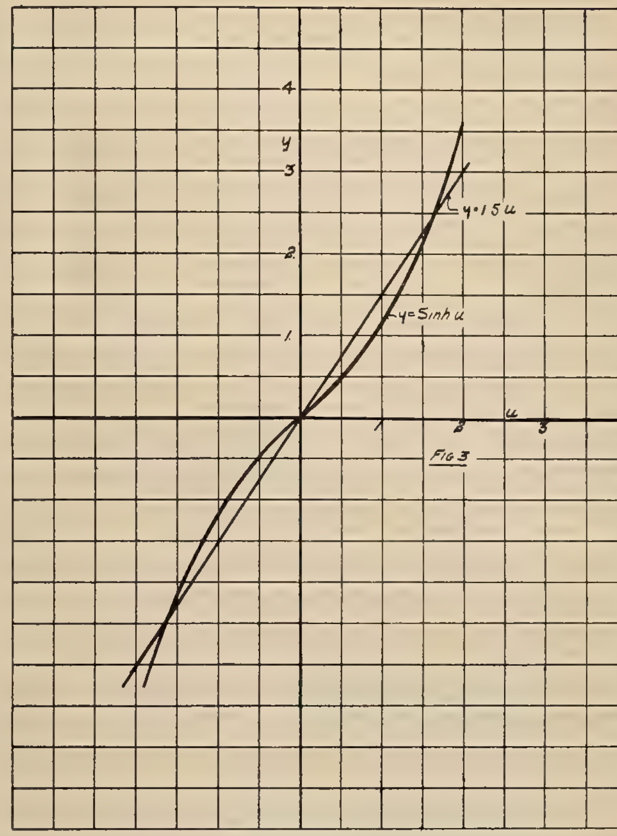


Fig. 3. Method of Solution by Intersections

Assuming 300 watts per mile per conductor leakage and corona loss we have

$g = 1.48 \times 10^{-7}$ ohms per mile.

$g + jwC = 1.48 \times 10^{-7} + j5.31 \times 10^{-6} = 10^{-6}\ (.148 + j5.31)$
$= 5.315\ \underline{/74^\circ\ 43'} \times 10^{-6}.$

These values are all computed for one wire to neutral in accordance with standard practice in such problems.

$m^2 = (r + jx)\ (g + jwC) = (.1127 + j.803)\ (.145 + j5.31)\ 10^{-6}$

$= 4.3 \times 10^{-6} \diagdown 171^\circ\ 28'.$

$m = 2.075 \times 10^{-3}\ \overline{/85^\circ\ 44'} = .000154 + j.002065$ an abstract coefficient per mile of this line.

$$m_1 = m/\ (g + jwC) = \frac{2.075 \times 10^{-3}}{5.315 \times 10^{-6}}\ \frac{/85^\circ\ 44'}{/74^\circ\ 43'}$$

$= .391 \times 10^3\ \underline{/11^\circ\ 1'}.$

$= 383 + j74.6.$

HYDROELECTRIC ACTIVITY IN NEW ZEALAND

The government hydroelectric plant at Lake Coleridge, about 70 miles west of Christchurch, was opened during the year with splendid results for Christchurch and vicinity. The city is now lighted by electricity, the tramcars are operated with power from this source, and many of the industries in and about the city secure their power from this plant, at very low rates in all cases. There is a demand for more current than can be supplied by the present installation of 6000 horsepower, and it is proposed to put in another unit of equal power.

THE PROBLEMS OF WATER REQUIREMENTS

BY FRED F. HENSHAW

(Accuracy in the study of discharge records for power development is of far greater importance than for uses in irrigation. In both of these studies, however, the minimum flow for a cycle of years must be carefully investigated. Previous discussions by the author, who is district engineer of the U. S. Geological Survey, stationed at Portland, Ore., have dealt with the mass curve and with the use of probability paper for analysis of discharge records. In this article the problems of water requirements are taken up in a manner that should prove usefu and helpful to engineers throughout the West. —The Editor.)

In making a water-power study, to arrive at the horsepower available or feasible, the engineer must determine the head and must make certain assumptions as to plant efficiency. The head can be obtained very closely. The efficiency of turbines has been raised materially within the last few years by careful study of design, but the probable gross efficiency of a hydroelectric installation can be foretold well within 5 per cent in the designing. In the case of a dam development there are generally no seepage losses. Those by evaporation are almost negligible. In short, the uncertainties in using the data are small.

In a typical irrigation project, where water is stored near the head of the river and diverted at, say, two points farther down, there must be considered, besides the actual water supply available,

1. Evaporation from water surface of reservoir.
2. Seepage losses in canals.
3. The duty of water, or the amount required for a proper irrigation.
4. The amount of return water that will be available at the lower diversion.

(1) Our information on depth of evaporation to be expected in a reservoir at varying elevations and different conditions of humidity, of climate, exposure to wind, etc., is not at all complete, and the data available are often inconsistent. I believe that an engineer can not be sure of his evaporation loss within 20 per cent, and such loss may be from 5 to 15 per cent of the total water supply.

(2) Seepage losses in canals are small in concrete-lined or other high-grade, well-designed structures, but ordinarily they are large, and often conditions will not warrant large expenditures to reduce them. The estimated loss for any given type of construction over a certain assumed canal line will generally be subject to an error of 25 to 50 per cent, and may amount to 10 to 40 per cent of the total supply available.

(3) The duty of water is a subject on which data are being accumulated rapidly, and the information becomes more valuable as more projects are put on a conservative basis of management. The quantity of water served to land under old projects is generally large, very often wastefully large, and hardly affords a criterion for assumptions as to the proper duty for a proposed project. Certainly a probable error of 15 or 20 per cent must be allowed on the duty of water, and this applies on the whole available water supply.

(4) The return water from a large irrigated tract must be studied when diverting below the point of seepage return, as considerable of this water can be recovered. As to the probable amount of such return under future conditions of complete development there appears to be greater uncertainty than in the case of evaporation, seepage, or duty. But it will almost always be found that the greater the canal losses and the larger the quantities of water applied, the greater will be the quantity of return water available for another project below. Thus the uncertainties of (4) tend to compensate those of (2) and (3).

Taken as a whole, the uncertainties in an estimate of the quantity of water required for a given area of land, made before the development of the project, will generally be at least 20 or 25 per cent.

In considering a problem of municipal water supply the uncertainties are similar to the first and third noted above. The error in estimating evaporation on a reservoir may represent a small percentage of total quantity of water required. The question of quantity of water required at any future time involves an estimate of the rate of growth of the municipality to be served and the per capita consumption.

In the control of floods, relief may be sought by dikes, dredging or channel alignment, to lower flood planes or to confine the torrents and keep the water away from the property. The hydraulic laws governing flow of water in flood channels are imperfectly known, and their application is difficult. Where it is proposed to reduce flood heights by storing water in reservoirs the process of estimating reduction in stage for any given reduction in discharge is relatively simple. Some of the big uncertainties in such a case are the length of time required for water to pass downstream from any given reservoir and the overlapping and flattening out of flood peaks.

Application of Discharge Data to Specific Problems.—One specific problem to which the graphic method of analysis just outlined may be applied is the determination of the continuous power at a given site. It is stated by Mr. L. F. Harza[1] in his report on the Columbia River power project:

> "The usual minimum flow of a river is a more significant quantity in planning a power development than the absolute minimum. The latter in fact can never be determined, and nearly all hydroelectric developments are subject to occasional deficiencies at times of extreme minimum. This is not necessarily an accident when it occurs, but is usually foreseen and planned for. An occasional sacrifice for a few days or even weeks once in several years is preferable from an economic standpoint to the failure to use the power during the major portion of the time when it is available. The extent of the application of this principle necessarily depends upon the char- of natural resources to an intolerable degree."

He selected as the usual minimum for Columbia River a discharge of 50,000 second-feet. From the

[1]Harza, L. F., Columbia River power project near The Dalle, Oregon; U. S. Recl. Service in coop. with State of Oreg., Report of Board of Review, p. 9, 1914.

probability curve for the minimum flow at The Dalles, it is noted that the value selected lies on the 92 per cent line; that is, the flow would be expected to be below this only 8 years out of 100. For the North Umpqua, with its low coefficient of probable variation, probably 800 second-feet would be taken as a safe minimum. The absolute minimum would be lower than this one year in four, but it would be 10 per cent lower only one year in ten.

To determine the economic development of a given site, secondary as well as primary power must be considered. Mr. Clemens Hercshel,[1] in a report on the utilization of the Great Falls of the Potomac River, states:

> "To use only 1000 second-feet (practically the minimum flow) for power out of Potomac River would be, to use a homely simile, as though we were using only the tenderloin out of a beef carcass and rendering unfit for any use, present or future, all the rest of the food available. That is to say, it would be extremely wasteful and permanently destructive of one of the natural resources of the country; going against the fundamental principles of all that is good in the modern doctrine of the conservation of natural resources to an intolerabel degree."

The study of the second-class power available necessitates the use of the curves of duration of flow. The criterion of development of second-class power depends on local market conditions. In parts of the East, power available half the time in an average year might be used, whereas in other parts of the country the power might have to be available for nine months continuously in a low year.

The application of the mass curve method to the study of irrigation with available storage has already been discussed for the Deschutes where the problem was relatively simple. There was only one reservoir, and the diversion point was practically at the storage site.

If the diversion is made below the reservoir, and a considerable quantity of water enters between, the mass curve is drawn for the reservoir as in the case of the Deschutes. The quantity stored is the total flow at the dam site during the non-irrigation season and whatever surplus there is at the point of diversion during the irrigation season. The draft from the reservoir is determined by the deficiency in supply at the point of diversion, and may occur during only half the irrigation season in some cases. The records of discharge at the diversion point are used in such a study only when the inflow below the reservoir can not supply the demand, which period may be all or only a part of the irrigation season. The records at the dam are used only when there is water available to store, and as far as such a study goes might be dispensed with for other periods.

Conclusions.—The determination of the discharge of streams of relatively uniform flow and steady regimen will usually justify a much higher degree of accuracy than is required in the case of more variable streams. Streams having a wide range from year to year in their low-water or average flow must be measured for a relatively long period of years, whereas on a stream of more uniform characteristics a shorter period of records may suffice. In other words, it would not seem advisable to seek the ultimate refinements of accuracy in studying a widely varying stream, but rather to give first consideration to prolonging the period covered by records.

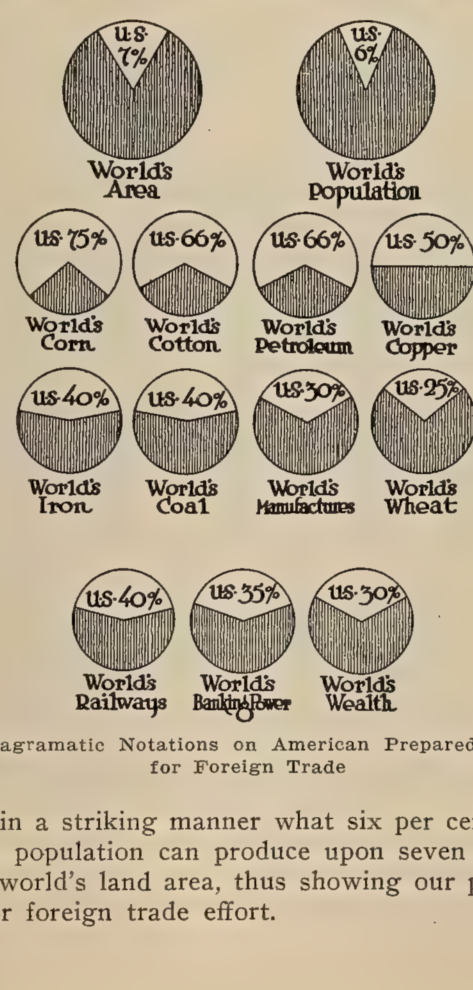
Records chiefly valuable for power studies must in general be more accurate than those which will be used mostly for consideration of irrigation; 10 per cent accuracy in many cases is probably all that our knowledge of use of water for irrigation justifies. On the other hand we should endeavor to get our power records well within 5 per cent.

It is highly important in the case of irrigation streams that records cover the year or cycle of minimum run-off, as the justifiable use bears a far closer relation to the permissible deficiency at such times than it does to the average run-off of the stream.

It is not absolutely essential to keep up records at a proposed point of diversion for irrigation during the winter; neither is it necessary that a station valuable only for storage be kept up during parts of the summer. Such a suspension of records might not be advisable, but it is often worth considering.

OUR PREPAREDNESS FOR FOREIGN TRADE

Walter F. Wyman, manager of the export department of Carter's Ink Company, has compiled some interesting notations on export trade as a profit maker for American citizens. In the following diagram he



Diagramatic Notations on American Preparedness for Foreign Trade

shows in a striking manner what six per cent of the world's population can produce upon seven per cent of the world's land area, thus showing our preparedness for foreign trade effort.

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[1]Water supply of the District of Columbia and water power at Great Falls: 62d Cong., 3d sess., House Doc. no. 1400, Washington, 1913, p. 48.

PHOTOGRAPHY FOR ENGINEERS

(The question of exposure often proves troublesome and perplexing to the engineer when gathering his data in the field by means of the camera. The author, who is with the engineering staff of the Pacific Gas & Electric Company, has developed some original ideas in the way of a curve for rapidly ascertaining this factor. The curve given herewith may be placed in the camera case and thus made readily available for future use when occasion arises for instant service with the camera as it so often does in engineering practice when one is not making a constant use of the camera.—The Editor.)

WHAT EXPOSURE SHALL I GIVE?

BY C. B. MERRICK

In the preceding article the fundamental influences which affect the photographic film were reviewed, and the next step is the placing of this data into a convenient form. The accompanying diagram (Fig. 1) includes all these various features, so

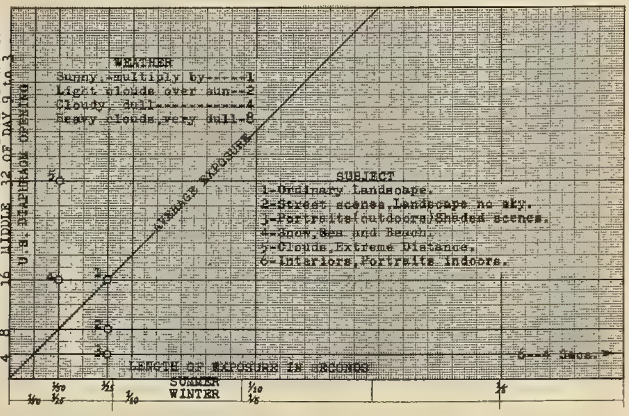


Diagram for Quickly Ascertaining Length of Exposure

that an exposure for any given set of conditions can be quickly estimated. The diaphragm openings are plotted as ordinates, and the length of the exposure as abscissae. Since the exposure for a sunny summer landscape is stop sixteen and 1/25 second, a line through the zero point and No. 1 (16 1/25) represents the average exposure. Any point on this line will give the same resultant exposure as No. 1, i.e. 8 1/50. Any point above the line will give a less exposure and any point below the line will give a greater exposure.

The subjects are listed in six groups and the best exposure for ordinary conditions is plotted for each group. The corresponding ordinate and abscissa give the exposure for each. Two scales are given for ordinates and two for abscissae, and the one is to be used which corresponds with the time when the picture is taken. If the weather is other than bright and sunshiny, the exposure must be increased by the appropriate factor in the weather table.

As an example, to photograph a street scene at 4 p. m. on a cloudy, dull day in January, we find point No. 2. The abscissa of No. 2 for winter is 2/25 second and the ordinate for late afternoon is stop No. 4. Since the weather is cloudy dull, this exposure of 4 2/25 must be multiplied by the factor 4. Therefore, the required exposure is No. 4 diaphram and 8/25 or 1/3 second. Open and close bulb quickly = ¼ second exposure. This requires a bulb exposure and therefore a tripod or firm support for the camera.

The diagram is made for use with the Uniform System (U.S.), but the corresponding f values of diaphragm opening are readily found from Table No. 1. The two systems have the same exposure value at

U. S. 16 = f. 16.

The speed of a lens is regulated not by the actual aperture of the diaphragm or by the focal length of the lens, but by the relation between the two. It will be seen from the diagram that by using a lens of

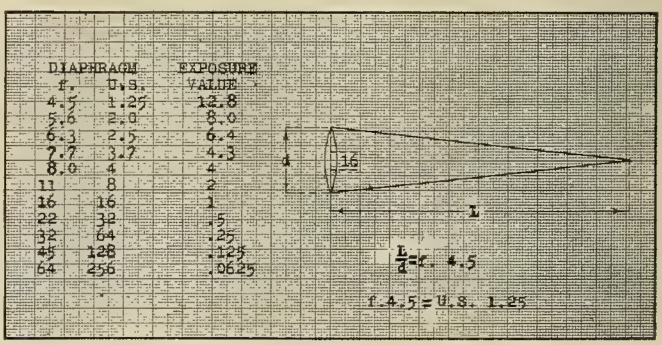
A Picture Taken at the San Francisco Exposition by Using Exposure Diagram

3 in. focal length, and ½ in. aperture we will obtain a certain unit intensity of light upon the film. If instead we use a lens of 6 in. focal length, the aperture for the same unit intensity will necessarily be 1 in. diameter. Consequently lenses are rated upon this relation, the f system being the ratio of the focal length to the diameter of the stop, the U. S. being the relation between the focal length and the area of the opening.

$$f = \frac{1}{d}$$

$$U. S. = \frac{1}{d^2}$$

From these facts it will be seen that for equal exposures the variation of the U. S. from 16 will be the square of the variation in the f system, i.e.:



Relationship of the Two Diaphragm Systems

(Concluded on page 392)

DEMAND METERS OE TIME LAG TYPE

BY W. A. HILLEBRAND

(Indicating wattmeters and ammeters with movement constrained by some device to give a suitable time lag so as to employ them as demand meters have found a useful and necessary place in the evolution of this important type of meter. In this installment of a series of three articles begun in the issue of May 1, 1917, the author who is with the engineering staff of the Pacific Gas & Electric Company, discusses the General Electric Type W, the Lincoln Meter and the Westinghouse R O Meter known as the time lag class of demand meters. The series will be concluded in the next issue of the Journal. —The Editor.)

General Electric Type W

This meter has been withdrawn from production but is referred to here because it represents an interesting development. It consists of a standard watthour meter element and disc, the latter controlled by three springs in series so that it may make three complete revolutions for full scale deflection of the pointer. Damping is secured by a battery of permanent magnets which retard the deflection of the meter disc. The characteristic curve of this meter is given in Fig. 7. Its principal disadvantage is that its time element is too short, the indication being unduly affected by temporary overloads.

Lincoln Meter

This meter is not in production but is referred to here because it is interesting as a type. The advantages claimed for it are moderate cost, great simplicity with consequent reliability and a time characteristic that makes it more suitable than other meters on the market. For a detailed description the reader is referred to Mr. Lincoln's paper.[1]

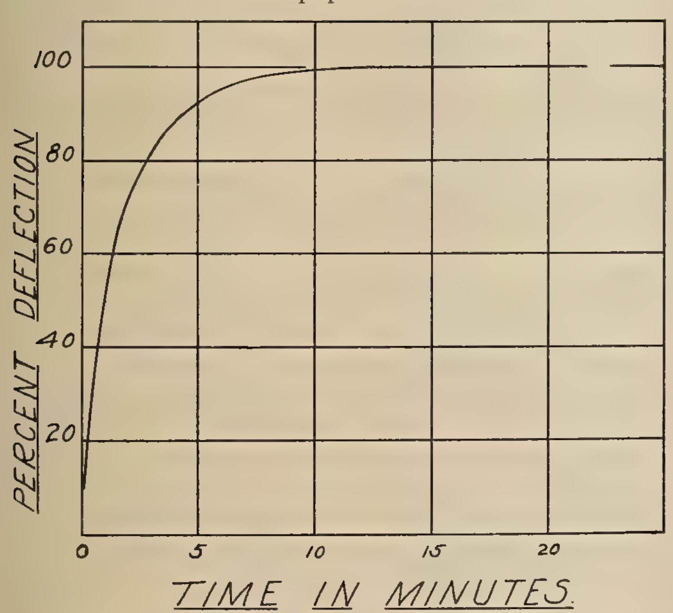


Fig. 7. Characteristic Curve of Induction Type of Demand Indicator—General Electric Design

The instrument is a thermal wattmeter with a time lag produced by the thermal capacity of the heating elements. It is shown diagrammatically in Fig. 10 and consists fundamentally of two resistances A and B connected to the secondary of a potential transformer into whose mid point the line current is introduced. The letters E and I indicate the respective instantaneous potential and line currents in the meter circuit.

The heating in element $A = R_A\ (I_e + I_i)^2$
$$= R_A\ (I_e^2 + 2I_eI_i + I_i^2)$$

The heating in element $B = R_B\ (I_e + I_i)^2$
$$= R_B\ (I_e^2 - 2I_eI_i + I_i^2)$$

Difference, when R_A and R_B are equal
$$= (R_A + R_B)\ (4I_eI_i^2)$$

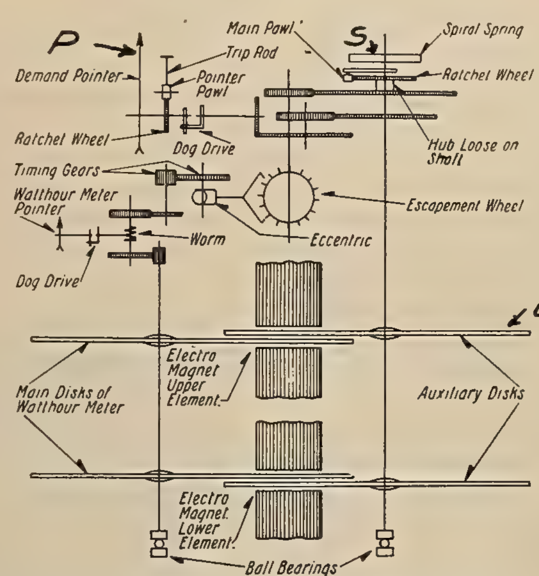


Fig. 8. The Westinghouse R O Meter

That is, the difference between the heating in the two elements is proportional to I_eI_i or to the power, under all conditions of wave form and power factor. If the temperatures of A and B are made proportional

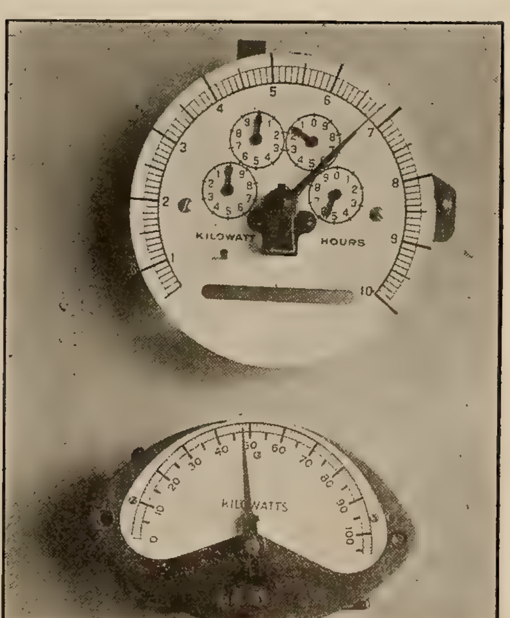


Fig. 9. Typical Face Appearance of Time Lag Type of Demand Meter

to the heat losses, then it only remains to find an indicator of these temperature differences to have a record of the power.

[1] Proceedings A. I. E. E. vol. 34, p. 2279.

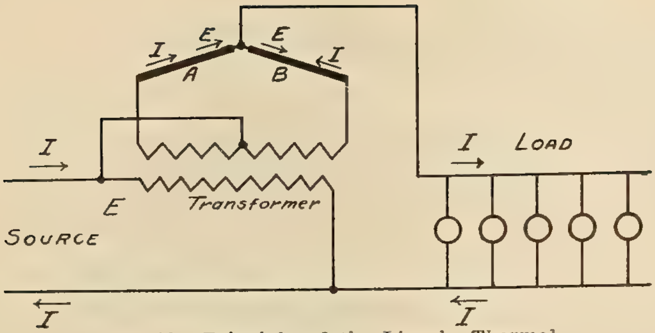


Fig. 10. Principle of the Lincoln Thermal Demand Meter

Westinghouse R O Meter

This instrument is shown diagrammaticay in Fig. 8. It is of the induction type, for use only on alternating current circuits, and consists of a standard watthour meter element and disc with a second spring-controlled disc operated on by the same torque-producing field, to serve as an indicating meter. The operation is as follows: The indicating element, E is controlled in its deflection by a spring S, and actuates, through a train of gears and dog, the indicating pointer P. The indicating element also drives through a pawl a ratchet and gear mounted loosely on its own shaft but constrained from turning freely by an escapement claw driven from the shaft of the watthour element. That is, the indirecting element is allowed to advance at a rate proportional to the speed of the watthour element, or to the load. As the indicating element has a uniform scale with a deflection proportional to the load, the time for it to attain the full deflection will be constant. That is, if it advances at a rate S on a one kilowatt load, it will advance at rate 2 S on a two kilowatt load but will have to deflect twice as far so that the time required for full deflection will in each case be the same.

When the load falls off the indicating disc drops freely back and comes to rest in a new position where the pawl picks up the ratchet wheel and the disc is again restrained from advancing.

This meter has the great advantage that it is self-contained with no separate timing device involving electrical contacts. Records covering many months show that the majority of meters operate satisfactorily, the indicating element being occasionally out only a few per cent. The recording element has proven very accurate.

On the other hand, the spring in such a meter is always a source of possible trouble and in this case the spring and disc combined have a temperature coefficient that under California conditions may make a difference of five per cent between summer and winter readings.

Trouble has also been experienced with the escapement claw binding on the teeth of the escapement wheel,, which occurs only at very light loads, stopping both elements. The watthour meter has a great advantage in this respect in that of whatever make, capacity or type, its dial has but one appearance and is read in but one way. Where one hundred and seventy thousand statements must be read and billed each month, this is a matter of great importance.

The pointer advances by steps of one-twentieth of a division each so that the maximum load is always in doubt by that amount. Furthermore, due to mechanical inaccuracy, the pointer does not always come to rest opposite division markings so that there may be a reading error of half a tenth division. For errors due to above causes to amount to not over five per cent, the deflection must be not less than two full divisions or twenty per cent of full scale. This is often difficult to obtain, particularly on seasonal loads with the current transformer selected for the peak.

The meter has the inherent error of its class previously referred to, with an additional peculiarity. Owing to the fact that the indicating element may drop back freely as the load falls off but may not advance, if the load is fluctuating periodically, due to a compressor or hoist for example, the meter cannot indicate even approximately the average load. This means that the nature of the load must be carefully considered before this type of meter is used.

The R O meter is in general designed for full scale deflection at 50 per cent overload, but as the meter will rarely be used without current transformers, which are never overloaded, it means that the upper third of the scale is useless. The first meters of this type were designed for 100 per cent overload but a reduction to 50 per cent overload was conceded in answer to strenuous protests demanding a meter with full scale deflection at full load.

The dial of the R O meter is shown in Fig. 9. The manufacturer's present standard is a dial graduated in kilowatts instead of in one hundred divisions, which has the advantage of applying the same instrument transformer constant to both indicating and recording elements. However, the writer has always demanded meters with the hundred division dial in order to eliminate errors in statement taking and billing, to which end it is considered advisable to have as few kinds of dials as possible.

(Continued from page 390)

f. 8 is $2 \times$ f. 16.

$\therefore$ f. 8 $= (2)^2 \times$ U. S. 16

f. 8 $=$ U. S. 4.

Thus knowing the correct exposure at any stop in one system, the correct exposure for any other stop in either system may be found.

Lenses are rated for the largest opening at which they will operate successfully, and this is called the speed of the lens. However, corresponding markings on all lenses will give the same exposure. For instance a rectilinear lens which has a speed of U.S. 4 (f 8) is faster than a meniscus lens, but 38 per cent slower than an f 6.3 anastigmat, and only 1/3 as fast as an f 4.5 anastigmat. Yet when each lens is stopped down to 16 (U. S. or f) the operating speed is the same for all, since the effective opening is the same. Referring again to the figure with table No. 1, an advantage will be found in the faster lens stopped down. This is due to the fact that the center of the lens only is used and the image is consequently more clear than with the smaller lenses. Wherever possible, it is best to use stop 8 or smaller so that the focus will be more nearly universal. Fig. 2 was taken with stop 16, 1/25 second on a bright summer day with the focus set for 100 ft. However the riffles on the water in the close foreground are clearly shown. Had a larger stop been used, the depth of field would have been noticeably less.

SHORT JOURNEYS IN PACIFIC LANDS

(Little journeys to Pacific Lands are increasing in number and importance. Engineering and commercial relations are fast being established by pioneers from America who are visiting these lands and forming firm and lasting friendships with our foreign neighbors. The author of the following article is making a tour of all the principal West Coast points of Mexico, Central and South America, in which he expects to consume something like twelve months in an exhaustive study of commercial and engineering relations. His reports, which will appear from time to time in the columns of the Journal of Electricity, should prove of unusual value to engineers throughout the West in that the author is thoroughly familiar with hydroelectric conditions, having been at one time commercial engineer for the Southern Sierras Power Company and a contractor of large transmission line construction in the West.—The Editor.)

THE WEST COAST OF MEXICO

BY J. W. FINCH

The Pacific Coast is just awakening to the vast opportunities offered by her neighbors, the wonderfully rich Latin-Americas. Abounding in minerals, tropical fruits, coffee, cacao, hardwoods and innumerable of nature's gifts, her peoples friendly and welcoming American enterprise, this is a field we can no longer afford to leave undeveloped. Southern California has enjoyed considerable business with the west coast of Mexico and some comparatively small business with some of the Central American republics. San Francisco and Puget Sound ports have for years been shipping goods of many kinds to Mazatlan, the principal port of entry on the west coast of Mexico, to Guatemala, Salvador, Honduras, Nicaragua, Costa Rica and Panama in Central America and Colombia, Peru, Ecuador and Chile, and in some cases to Bolivia, in South America. You have only to refer to your map to realize the advantageous geographical position of our own west coast with the west coast of the countries I have mentioned.

Eastern markets have been, and are now, shipping through New York and New Orleans to east coast points and thence overland, to supply the western markets of Central America and through the Panama Canal direct to the west coast of South America. European markets have sent their ships direct to these countries and until forced to curtail their exporting they controlled the greater bulk of the business. While we have been content to remain at home and graciously accept such export business as has been offered us, sending our representatives to these lands only occasionally, Germany, England, Belgium, France and Italy have canvassed the field thoroughly with greater or less success. Germany in particular has been a great factor in this field on account of her aggressive sales methods and in a great measure, because of the cheapness of her export products and the long time credits she has extended. For many years we feared to enter in competition because of these conditions, but since a few enterprising Americans succeeded in introducing our goods, the superiority of our products as a whole is being recognized and we are able to sell at higher prices and our goods are continually gaining in prestige. Some American concerns and individuals have abused the confidences gained and we will find some opposition to our business methods, but by carefully studying the demands of the countries and the characteristics of the Latin people we should be able to establish a lasting fellowship and profitable business relations with them.

Modern Business Structures in Mazatlan, Mexico, with Street Scene Awaiting the Advent of Efficient Transportation Facilities

The writer is embarking on a commercial trip, covering the southwestern portion of Mexico, the Central Americas and the west coast of South America, in the interests of a group of Los Angeles and San Francisco manufacturers and jobbers. A number of non-conflicting lines are to be represented, with a view to establishing permanent relations and studying trade conditions in the countries visited. In preparing for this journey there was naturally the desire to learn something of the countries to be visited, the characteristics of their peoples, their methods of doing busines, the class of goods generally imported, transportation facilities, hotel accommodations, etc. Considerable difficulty was experi-

enced in obtaining specific information along these lines. There are a number of publications pertaining to the subject, but they deal mostly in generalities, and while of considerable assistance in making one's plans and preparations, there are many things that must be learned by experience.

The first question is transportation; to reach Mazatlan, Mexico, it is possible to go by rail over the lines of the Southern Pacific Company, through Nogales, Arizona. From there trains are operated three times a week although accommodations are very poor. At this time trains are not operated at night in Mexico and passengers are required to stay over-night at hotels along the line. It requires five days by train from Los Angeles to Mazatlan. This point is best reached via the Pacific Mail Steamship Company's steamers which leave San Francisco every ten to fifteen days. The time consumed is six days and while some of the boats are old and slow the service withal is very good and the trip is usually a very comfortable and delightful one. These boats proceed from Mazatlan, south, touching at important points along the west coast of Central America and passing through the Panama Canal to Cristobal, C. Z. If one contemplates proceeding directly to Central America, considerably better time could be made by journeying to New Orleans over the Southern Pacific Railroad, then taking one of the commodious steamers that run from there several times a week, across the Gulf of Mexico and proceeding overland to the west coast. If one should decide on this route, inquiries should be made regarding railroad connections in the countries to be visited.

It is now necessary to have in your possession, a United States passport before being allowed to enter certain countries. Your steamship agent will probably advise you to the contrary, but some travelers have had some sad experiences because they were not so prepared. Application can be made for a United States passport through the clerk of the United States District Court in San Francisco or Los Angeles, which application is sent to Washington for the signature of the Secretary of State. Our government will not now issue passports for travelers going into the Republic of Mexico, but one should be obtained from the Mexican Consul General at San Francisco. Before issuing a passport the Mexican Consul requires a letter of introduction from some high public official or from the chief of police in your city, which letter is retained in his files.

The passage from San Francisco to Mazatlan, Mexico, is a very delightful one when the sea is quiet and the weather moderate as it was on our trip. As we get into Mexican waters the sea becomes smoother and the weather slightly warmer. Life on shipboard does not become monotonous as various diversions are offered and many interesting persons are encountered. We were due at Mazatlan early in the morning, but on account of a heavy fog we lay in the stream until the early forenoon, then proceeded to our anchorage about a mile off shore. On account of this port's shallow harbor it is not possible for ocean going steamers to enter. Passengers are disembarked by means of gasoline launches and at low tide are transferred from the launches to row boats, which are beached. They are then carried ashore on the backs of the "boteros" or boatmen until the boat is lightened enough to allow it to be pulled up out of the water. Trunks and hand-luggage are brought ashore in the same manner. When the steamer first comes to anchor, it is boarded by the immigration officials who unwind a long reel of red tape, scrutinize all of the passengers whether bound for Mexican ports or farther south, examine carefully the passports and require all the officers and crew to pass before them, before allowing anyone to land.

In the meantime a swarm of launches, row boats and lighters approach the steamer awaiting the departure of the immigration officials. The "estibadores" or stevedores then scramble aboard followed closely by the launch men who begin bidding against one another for the privilege of carrying passengers and luggage ashore. This expense must be borne by the passenger in addition to his steamship ticket. The amount you pay varies with your ability to bargain with the "lanchero." All freight for this port must be transferred to lighters and then towed by a tiny tug boat to an equally tiny wharf. At high tide the lighters unload directly on the wharf by means of a crude boom derrick operated by hand and when the tide is low the lighters are loaded and unloaded by a string of "cargadores" or porters who wade out into the water, sometimes waist deep, and carry the freight ashore on their heads. The load is supported by a round pad, high up on the back between the shoulders. The pad is attached to the forehead by a broad strap. They are able to carry very heavy loads in this way, pieces weighing 100 kilos (about 220 lbs.) and sometimes heavier, are handled with comparative ease. At one time a number of gasoline hoists or cranes were installed for the purpose of handling freight from the lighters but these were not welcomed by the "cargadores" and a strike was the result. The use of the cranes was therefore discontinued and they are now lying idle.

All freight entering is passed directly through the customs house for appraisal. Passenger's baggage is of course inspected and particular attention is paid to anything which is packed in a box or nicely wrapped, even though it is in a trunk or hand bag. My experience with the customs house here was interesting. Several samples which I am carrying with me were passed through without any comment although one sample which weighed five kilos was assessed for a small amount. All personal wearing apparel was passed without comment except three cardboard suit boxes were in a trunk of my wife's clothing. These boxes were in a trunk and were used merely to protect the articles which they contained. The fact that the clothing was carefully wrapped and in the boxes was responsible for an assessment of $48.25 Mexican silver. I protested of course and after much discussion the assessment was reduced to $29.00 which I had to pay. Had this clothing been packed loosely in the trunk without the boxes it would have undoubtedly entered free.

American money is accepted freely here and is quite commonly used, although the rate of exchange is $1.80 Mexican silver for $1.00 American silver or currency, or $1.95 Mexican silver for $1.00 gold. The rate of exchange is revised every ten days by decree from the capitol. Merchants generally pay for their goods with United States currency and as there are no banks here at present it is difficult to obtain drafts on the United States.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Cost data per acre foot for different capacities of unlined reservoirs have long been lacking. Below will not only be found curves that cover this important relationship but a section showing all details in the construction of a typical unlined earth reservoir is given. The author is a well-known irrigation specialist at the University of California and as a consequence this information should immeasurably forward the use of economic application of electrical energy in pumping where unlined earth reservoirs are necessary.—The Editor.)

UNLINED EARTH RESERVOIRS FOR PUMPING PLANTS

The greater proportion of reservoirs used with individual pumping plants are constructed entirely of earth. Where the soils are too light to prevent seepage various kinds of lining such as clay puddle, manure, oil or concrete may be used. The unlined earth reservoir is the cheapest form and where the soil is a compact silt loam or heavier can be made sufficiently water tight for most purposes at small expense.

Earth reservoirs for pumping plants are usually constructed by excavating the material for the banks from the inside area. For each size of reservoir there will be a certain depth of cut over the inside area which will furnish sufficient material with which to construct the banks. The greatest capacity in relation to the material in the banks is secured in a circular reservoir. Earth reservoirs are practically always built either square or rectangular in shape as the saving in material with a circular form is small and the irregular areas of land not in the reservoir are of little other use. Circular concrete reservoirs are frequently built.

Reservoir Banks.—A bank which has to withstand the pressure of water has a very different duty to perform than an ordinary earth fill. Flatter slopes are required on the water side to prevent injury by wave action and to increase the distance seepage water must travel through the bank. A slope of one vertical to two and a half horizontal is needed on the water side. Large earth dams even when protected with riprap to prevent wave erosion are usually given a slope of 3 to 1 on the water side. Ordinary earth fills not subject to wave action will stand on slopes of one vertical to one and one-half horizontal and such a slope can be used on the outside of small reservoir banks. This slope is usually on road and railroad fills. On high banks the erosion from rainfall on such slopes may be troublesome, on small reservoirs this is not important.

The banks should be given a top width of 2 ft. in all cases and for the larger sizes 3 or even 4 ft. would be preferable. The width should be greater in lighter soils than in those containing clay.

The full height of the bank cannot be used for the storage of water; some free board as it is called or excess height is required. For small reservoirs not subject to excessive wind action and having banks with the slopes recommended one foot of freeboard should be sufficient. Where linings are used smaller amounts may be satisfactory.

In many cases reservoir banks have been built with steeper slopes and less top width than the amounts stated above. Such banks, however, when in use gradually flatten their inside slopes and reduce their usable heights so that eventually no more storage is available than would have been secured with a well proportioned bank containing the same amount of material. The use of light banks increases the material danger of breaks during the period when adjustment is taking place.

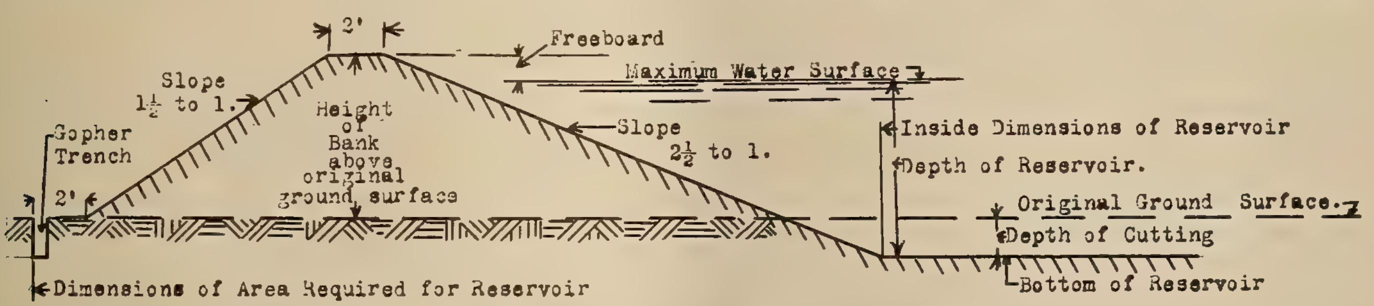


Fig. 1. Section of Reservoir Embankments

In building the banks, the ground should be cleared and plowed so that leakage along the line of contact between the original ground and the bank may be avoided. In building the banks, the earth should be distributed and the teams driven along the bank so as to pack the fill as it is made.

Where there is a marked prevailing wind from one direction the banks of the opposite side may need protection against wave action. This may be secured by a layer of gravel although gravel is not usually accessible at such reservoirs. A fence consisting of posts driven into the bank about a foot below the high water mark with wire into which brush is woven will usually give good results. Another method is to spread the brush on the slope and hold it in place by wire netting spread over, and held down by stakes. The bank may be given a flatter slope on the side exposed to wave action.

Spillways.—It is sometimes desirable to provide spillways in reservoirs to prevent their becoming too full and overtopping the banks. Where the reser-

voirs are filled from pumping plants spillways may not be provided. If the pumps are operated during the night or at other times without attention such spillways may be desirable. A width of 3 to 5 feet of the bank depending on the capacity of the pump may be cut down to the elevation of safe high water and protected against overflow either by concrete or wood lining. Any discharge over such spillways can be led to the field ditches or into the pipe lines. A vertical pipe may be set inside the reservoir with its top at high water level. Such a pipe or box can be connected with the outlet of the reservoir or with a separate outlet through the bank. The discharge into such an overflow spillway will be similar to that of a weir with a length equal to the circumference of the inlet. In special cases an arrangement of floats can be made by which the power may be shut off when the water reaches a certain height in the reservoir.

Gophers.—Burrowing animals, more particularly gophers, frequently injure the banks of reservoirs by forming openings through which leaks resulting in breaks in the bank may start. Gophers burrow in banks to get above flooding in the fields or to secure food from the roots of vegetation growing on the banks. Keeping the banks clear removes the latter cause. The best prevention is a trench dug around the reservoir having a depth greater than the depth of gopher burrows. Such a trench 18 inches deep will usually be effective. In extreme cases a close meshed wire may be set in the bank so that gophers can not burrow through.

The outlets for earth reservoirs may consist of either pipe or wood boxes. The character and cost of these have been discussed in a previous article.

Cost of Earth Reservoirs.—In Table 1 data on earth reservoirs having banks as shown in Fig. 1, are given. The inside dimension is that of the finished reservoir. The more usual sizes of square reservoirs are included in the table. Reservoirs may be built in a rectangular shape in order to utilize available land. The length of bank required for equal capacity will be greater with a rectangular reservoir than for one built as a square. Estimates of the material required for rectangular reservoirs where one dimension does not exceed twice the other can be made from Table 1 by finding the size of square reservoir having equal area and increasing the material by about 5 to 10 per cent depending on the difference from a square.

The depth of cut over the inside is figured for level land and without allowance for swell or shrinkage in the bank. Where sloping sites are used the height of one bank is decreased and that of the other increased. As the material in a bank increases more rapidly than its height this will result in an increase in the quantity of material on uniformly sloping land for an equal capacity. For the small slopes usually found where such reservoirs are used the difference in the material required on level and on sloping ground is not large.

The area of land required is figured to include the banks and an additional 2 ft. in width for a gopher trench. An allowance for the value of the land used is necessary if the costs of reservoirs of different sizes and depths are to be compared. Land used in a reservoir represents as real a portion of the cost as the expense of construction.

The estimates of cost are based on prices which can usually be secured. Such costs vary with different conditions and the figures given may be exceeded in some cases. This is particularly true of the value of the land.

The cost of earth work is taken as 12c per cubic yard. This cost can usually be secured where the work is well handled. It represents about 40 cubic yards per day for a 2 horse Fresno or 60 cubic yards for a 4 horse Fresno.

In order to compare the relative costs of small deep reservoirs with larger more shallow ones the costs per unit of capacity are given. These figures show the lower unit costs secured in the larger sizes. For a given area of reservoir the unit costs decrease with the increase of the depth when the value of the land is included. For unit prices used in these estimates there is little difference in total cost for the different relations of area and depth which may be used for the same capacity. Reservoirs 100 by 100 by 4, 120 by 120 by 3, 150 by 150 by 2 have equal capaci-

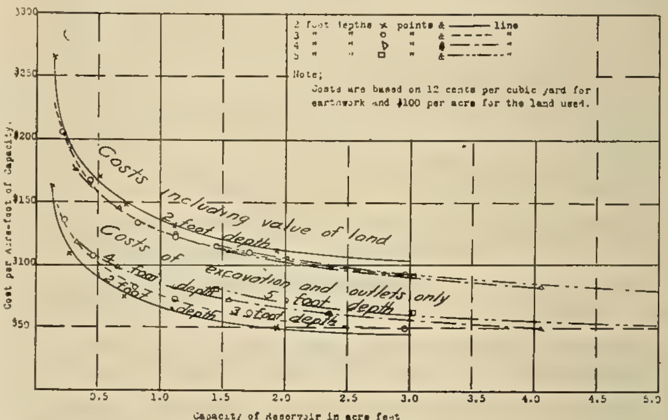


Fig. 2. Relative Cost per Acre Foot of Different Capacities

ties, the costs per acre foot being $125, $123 and $132 for the unit costs used respectively. For higher land values the smaller and deeper reservoir would give even lower relative costs. From considerations of use and reduction in seepage losses the 4 ft. depths would be preferable even at somewhat higher costs.

These estimates of relative costs are plotted in Fig. 2. These are given both for construction cost alone and for costs including the value of the land. For construction costs alone the costs per acre foot of capacity are somewhat higher for the deeper reservoirs if a uniform price per cubic yard is used.

If the land is valued at $100 per acre the costs for any capacity show practically no difference for depths of 3, 4, or 5 ft., being slightly higher for 2 ft. depths. For higher land values the greater depths are more economical. At a land value of $100 per acre, the value of land represents from 30 to 50 per cent of the total cost.

As stated these comparisons are based on banks of the recommended dimensions shown in Fig. 1, and for balanced cut and fill on level ground. If the inside slope of the bank is made steeper, the saving in cost is not large. For balanced cut and fill reservoirs with 2 to 1 inside slopes, the difference in cost from those having 2½ to 1 slopes is from about 12 per cent for small sizes to 5 per cent for shallow larger sizes. For 1½ to 1 slopes the saving in cost over those with 2½ to 1 slopes varies similarly from about

20 per cent in the smaller sizes to 15 per cent in the larger.

If no site is available for a reservoir at sufficient elevation so that it can be drained onto the land if built in balanced cut and fill, the banks must be built from earth secured outside the reservoir, the natural ground surface becoming the bottom of the reservoir. This increases the material which must be handled. The percentage of increase in cost varies with the size and depth. For two foot depths of storage the increase in cost over balanced cut and fill varies from nearly 50 per cent for 50 ft. sizes to 10 per cent for the 200 ft. size. For four foot depths of storage the increase in cost varies from nearly 100 per cent for the 50 ft. reservoir to about 25 per cent for the 200 ft. size.

Table 1.—Data on Earth Reservoirs

Inside Dimensions of Reservoir—ft.	Depth of Water Stored—ft.	Capacity—acre ft.	Capacity—gallons.	Height of Bank above Bottom of Reservoir—ft.	Depth of Excavation over Inside to Make Bank—ft.	Height of Bank above Ground Surface—ft.	Total Cubic Yards in Embankments	Total Area of Land Required—acres	Estimated Costs: Excavation at 12c per cu. yd.	Estimated Costs: Value of Land Used at $100 per acre	Estimated Costs: Cost of Outlet	Estimated Costs: Total Cost	Total Cost per Acre foot of Capacity	Cubic Yards Excavation per Acre foot Capacity
50x 50	2	.14	45,000	3	1.1	1.9	110	.14	$ 13	$ 14	$ 10	$ 37	$265	790
	3	.23	75,000	4	1.6	2.4	174	.17	21	17	10	48	209	755
	4	.33	107,000	5	2.2	2.8	244	.19	29	19	10	58	176	740
75x 75	2	.29	94,000	3	.85	2.15	183	.25	22	25	10	57	194	620
	3	.47	153,000	4	1.3	2.7	289	.28	35	28	15	78	166	615
	4	.66	215,000	5	1.8	3.2	416	.32	50	32	15	97	146	623
100x100	2	.50	163,000	3	.7	2.3	270	.39	32	39	15	86	170	535
	3	.80	261,000	4	1.05	2.95	413	.43	50	43	15	108	134	515
	4	1.12	364,000	5	1.5	3.5	593	.48	71	48	20	139	125	530
	5	1.45	472,000	6	1.95	4.05	800	.52	96	52	20	168	116	550
120x120	2	.72	235,000	3	.6	2.4	328	.52	39	52	15	106	148	460
	3	1.12	364,000	4	.95	3.05	520	.56	62	56	20	138	123	465
	4	1.55	505,000	5	1.35	3.65	750	.62	90	62	20	172	111	485
	5	2.01	655,000	6	1.75	4.25	1005	.66	120	66	25	211	105	500
150x150	2	1.10	358,000	3	.5	2.5	422	.74	51	74	20	145	132	380
	3	1.71	557,000	4	.8	3.2	685	.81	82	81	25	188	110	400
	4	2.35	765,000	5	1.15	3.85	975	.87	118	87	25	230	98	415
	5	3.03	986,000	6	1.5	4.5	1312	.92	158	92	30	280	92	435
200x200	2	1.93	629,000	3	.4	2.6	593	1.23	71	123	25	219	113	310
	3	2.96	965,000	4	.65	3.35	970	1.30	116	130	30	276	92	330
	4	4.05	1,320,000	5	.9	4.1	1385	1.38	166	138	30	334	82	340
	5	5.15	1,680,000	6	1.25	4.75	1880	1.46	226	146	30	402	78	365
	6	6.38	2,080,000	7	1.6	5.4	2440	1.54	293	154	30	477	75	380

DRAINAGE AND IRRIGATION BY CORRESPONDENCE FOR FARMERS

To aid the thousands of California farmers who could greatly improve the value of their farms by draining patches of swamp or water-logged or alkali lands, the University Extension Division has arranged for a new correspondence course on "Irrigation, Drainage, etc., for Rural Districts." It will be given by William F. Sullivan, C. E., an expert in irrigation and sanitary engineering.

Besides learning how to rid a farm of ground water and how to drain patches of wet land, the correspondence students will study economical methods of irrigating small tracts from wells and of building small reservoirs and irrigation ditches, and how to handle efficiently problems of the farm home. There will be practical instructions also in how to make good concrete and in how to estimate the cost of masonry work and of irrigation and drainage undertakings.

SUGGESTIONS FOR OFF-PEAK HOURS—I

Whether you are an engineer in the busy thoroughfares of prosperous cities of the West or one of the many necessary links in the chain of operation of one of the mountain hydroelectric plants, the call to the country this season of the year is irresistible. The question often comes to each of us as to how we may pass the time in these off-peak hours to the best advantage to ourselves and contribute to the happiness and enjoyment of those about us.

If you want to be young again and be an agreeable daddy, husband or friend, try a little contest, when next you stroll in the hills. Whether accompanied by daughter, son, wife, sweetheart, or friend, start a little game as follows: One point for each different wild flower you can name, one-half point for those you discover but can not name, and three points for each new discovery you make in succeeding trials. You will soon find that, although you now know but possibly six to ten wild flowers, you will easily enumerate a hundred before the season is over, such will be the results of inquiry, books and other stray sources. And best of all you will soon find that these myriads of little new friends will be playmates for a life time. And friends indeed they will prove—because that grouch you have had so long will soon be replaced by a new outlook on life and service to the engineering fraternity will be blessed by a renewed clear brain of one of its members.

As the welfare of the nation and the nation's defense are absolutely dependent upon an adequate supply of coal for all purposes, and of iron ore for the iron and steel mills, the executive committee of the special committee on national defense, of the American Railway Association, has ordered all railroads of the United States to give coal and iron ore preference over all other traffic.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(An old sign hangs up in a secluded cabin in the high Sierras which reads thus: "God helps them that help themselves, but God help the man that's caught helping himself here." Below will be found an interesting article on helping the electrical dealer to help himself. The article is written by the power apparatus specialist of a well-known supply house in San Francisco. Read it. It will certainly help the contractor and dealer to help themselves and we feel quite sure the calling in of the Almighty to wreak vengeance as stated in the cabin sign above mentioned will never take place. Other interesting and helpful articles on heating of flood lighting projectors, ordering switches and fuses for single-phase motors, and precautions in testing dry cells may also be found in this department.—The Editor.)

HELPING THE ELECTRICAL DEALER TO HELP HIMSELF

There are very few things on this old world of ours that really "happen"—there is a well defined reason back of everything. And above all the shining examples of this homely truth there is business—Business does not happen—it is created, and it is the successful merchant, whether he be an electrical dealer or a dry goods man who knows how to use all the tools at his disposal to create business and profits.

The electrical dealer has been backward in his attempt to create business. He has stocked his store with merchandise, put a few miscellaneous items in his window and then set back and waited for something to "happen." Nothing does, and thereby hangs this tale.

Now let us assume that the dealer has fixed up his store interior, has a nice gold lettered sign hanging before his door, and his name in shining gold-leaf letters across his window. His first line of attack is his window. To put a first-class, attractive, timely, business-getting display in his window is his first duty. "But" says the dealer, "I know nothing about window displays—I can't trim a window so that it will look and be attractive. Further, I can't letter signs and it's too expensive to have them lettered."

What an unfortunate man indeed is the dealer who will not take his eyes off the ground. Electrical distributors and manufacturers know that it pays them to help the dealers help themselves. So a number of them have developed an extensive window display service through which the dealer receives all the necessary display material to set up a window display that will fulfill all the duties and requirements of his particular window and business. There are displays for lamps, batteries, washing machines, vacuum cleaners and irons; and there are displays around the many holidays and seasons. For instance, this service includes displays for Easter and Fourth of July, Washington's Birthday, and so on. This service is complete and is one of the most important tools at the dealers' disposal to create business.

Next comes the envelope stuffer. Nobody familiar with business getting methods questions the efficacy of the envelope stuffer which is nothing more than a small folder designed to fit in an envelope and be enclosed with a letter. These little folders properly designed pave the way for many a sale of the commodity they advertise. But these stuffers are expensive to produce in small quantities—quite too expensive for the electrical dealer. So the electrical distributors have printed them for the dealer who gets as many as he wishes on any appliance that he wishes—and he gets them for the asking—all imprinted with his name and address and ready for work. These stuffers are never designed to lie around on shelves and counters collecting dust. They are designed to be mailed to customers with bills and letters to collect business. Stuffers are like shells—which you know are effective only when they are shot from the guns for which they were designed—shells stacked nicely on the ground are pretty to look at but they'll never win a battle there.

Next we come to newspaper advertising. Nobody denies the business pulling power of an effective newspaper ad. The reason nobody denies it is simply because there exists nobody today who at one time or another has not bought something directly because of the influence of a newspaper ad. And so the electrical dealer can profitably employ newspaper space to sell the merchandise he has upon his floor and shelves. But where is there the electrical dealer who can design an ad. that will have the desired results? They are few and quite far between. That in no way is a slur on the dealer's ability—it takes a certain specialized skill to write a business-getting ad. and the large electrical distributors have men who write ads. of this character and do nothing else. The fruits of their labors are given to the dealer for his use. He can get newspaper ads. on any article he desires, in any size he desires—by asking for them. Simple enough, isn't it?

And then there are letter-head electrotypes, lantern slides, moving pictures and any number of special helps that the dealer can get to increase his sales which really means an increase in the sales of the people who sell him his merchandise.

The free printed matter, the free lantern slides and the free newspaper electrotypes are offered not in an altruistic spirit, but because it is good business—good business for the manufacturer and good business for the dealer who is progressive enough to use them. Let the dealer remember that he is one of the outlets, that is, one of the channels of distribution. In other words, the manufacturers are the generators and the dealers are the service leads that provide an outlet for the goods of the manufacturer; and when the service leads or dealers are a satisfactory outlet, the manufacturer accomplishes his purpose and he benefits—but do not forget that the dealer benefits too. The manufacturer sells to the dealer and provides him with the means for reselling these goods to the ultimate consumer. The manufacturer is desirous of having the dealer sell his goods so that the dealer will be in a position to buy and sell again.

Of course, the manufacturer profits—but doesn't the merchant profit at the same time?

One of the vital points in connection with dealers' helps—one that is so often under emphasized and little appreciated by the dealer himself—is the relation of these sales helps to the National Advertising Campaigns in which thousands of dollars are being spent to create a demand for electrical appliances. If when this demand is created there is no way of cashing in on it, all the advertising avails the National Advertiser nothing.

One case in point—that of the Western Electric Sewing Machine that is being nationally advertised. These national advertisements are creating a desire on the part of the women readers to own or at least to know more about one of these machines. Now no woman is a mind reader—she cannot instinctively know that John Smith handles this machine in her town unless John Smith tells her. John Smith can tell every woman in his town that he handles the machine—he can tie up to and cash in on the national advertising and the demand it creates. He can do all this by using his dealers' sales helps. If this John Smith is on his business toes he will have a lantern slide in the movie theatre telling that he handles the sewing machine that is so prominently advertised. He will run an ad. in his local newspaper telling about his store and the sewing machine he handles, and lastly he will have a sewing machine display in his window. If he has prepared himself this way, no woman in his town will fail to connect his store with the nationally advertised sewing machine—and the constant bombardment she receives from his advertising artillery will finally make her capitulate and the sale is easily made. And what is true of the sewing machine is likewise true of the washing machine, the vacuum cleaner and all the appliances the electrical dealer handles. No electrical dealer will complain of poor business if he goes after good business. No business is really poor—some businesses are simply better than others, and the best business is always the one that is best advertised.

It is the wise electrical dealer who knows his own game and knowing it, plays it to the limit. That is all this electrical business is—a great big game—with a zip and a zest to it so often lacking in other businesses. And the electrical dealer is doubly fortunate because he holds all the trump cards—every sales help is a trump in the sales game—how long will he continue to hold the big cards and play the little ones? How long will he refuse to see that it's the trump cards that take the tricks? And how long will he keep on doing a socket business when, with a little judgment and the judicious use of the advertising matter he has at his disposal,—he can sell the big appliances—sales that make the old cash register bell ring with joy?

HEATING OF FLOOD LIGHTING PROJECTORS

Flood lighting projectors should not be used in show windows or under similar conditions even for temporary installations unless ample ventilation is provided. These devices are not designed for indoor service and where space is restricted or ventilation poor they are likely to heat up to a dangerous temperature, especially with lamps of the larger sizes. In any case the arrangement of the window should be such that inflammable materials are not liable to come in contact with the projectors. Further, the conductors should be of ample size and of the slow-burning or asbestos covered type.

A case in which these precautions were not observed came to the writer's attention some time ago. A projector having a 250-watt lamp was placed in a small store window which was completely enclosed. In a very short time the lamp became so hot that the filament drooped and produced a short-circuit, which might have caused overheating of the leads, which were of ordinary No. 18 cord, had the circuit not been properly fused.

In anticipation of the dangers from overheating of high wattage lamps improperly installed, rules governing such installations were incorporated in the National Electrical Code some time ago under the caption "Gas Filled Incandescent Lamps." This section should always be consulted before making such installations.

ORDERING SWITCHES AND FUSES FOR SINGLE-PHASE MOTORS

Single-phase motors of the repulsion induction type have the windings connected so as to permit operation on circuits of either 110 or 220 volts. This is accomplished by bringing out four leads—two from each half of the winding—by means of which the windings can be connected in series or parallel according to the circuit voltage.

In ordering switches and fuses for this type of motor it is therefore necessary to specify on which voltage the motor is to be operated since the capacity of the switch and fuses will depend upon the voltage.

This point is overlooked nine out ten times and is the cause of many delays in handling such orders.

PRECAUTIONS IN TESTING DRY CELLS

Do not test cells while they are cold. Before testing put them in a moderately warm room for 24 hours.

Be sure that the ammeter is reasonably correct by checking it occasionally with a standard ammeter.

Wires on the ammeter should not be more than 12 inches long and not smaller than No. 12 wire.

Hold the terminals of the ammeter on the binding posts—not on the carbon.

Do not keep ammeter in circuit more than 3 seconds. Otherwise the short-circuit will exhaust the cell.

OIL FOR SMALL POWER MOTORS

A prominent manufacturer of motors and fans gives the following information about oil for small motors: The best oil for small motors is a medium weight mineral lubricating oil. Thin oils, such as used for typewriters, guns, etc., will not give satisfaction, and should not be used. A heavy oil, such as cylinder oil, will gum the bearing and be likely to ruin the motor. For the same reason only clean oil should be used.

Do not use vaseline for motor bearings. Never use any vegetable or animal oil, such as lard, linseed, cottonseed or olive oil. They are not lubricants.

PACIFIC COAST SECTION N. E. L. A. CONVENTION

(Hydroelectric activities throughout the West have assumed a serious, sober tone of expression due to the present critical state of affairs in the national government. It is now recognized that vast service can be rendered the national government by keeping such utilities in efficient and effective operation. The Pacific Coast Section of N. E. L. A. is fortunate in having as its president one who is well qualified, through long years of military training combined with operating of utility organizations in civil life, to render unusually effective service at this time. In the next issue of the Journal full announcement of new committees and new activities for the year's work will be set forth by Captain H. F. Jackson, president of the Pacific Coast Section. Below will be found the first installment of transcribed notes taken at the recent Riverside convention.—The Editor.)

FIRST ANNUAL CONVENTION, NATIONAL ELECTRIC LIGHT ASSOCIATION, PACIFIC COAST SECTION

Riverside, Cal., April 19, 1917, 2 o'clock P. M.

President Ballard: It becomes my privilege, and I consider it a very great honor, to call to order the First Annual Convention of the Pacific Coast Section of the National Electric Light Association. We have come from hundreds of miles apart to meet here in convention for the first time.

I believe that one of the main things which we will all get out of this convention particularly is the value of getting personally acquainted one with the other. We must all come out from under the naturally modest and retiring disposition of all electric and utility men and greet each other. The officers cannot, of course, go around hunting up all the members of the association, but the officers will all of them be very glad if the members will hunt them up.

I shall be very happy if this convention will rest in our memory as an unconventional convention. In many respects I think it will be different from the ordinary conventions which some of us have been used to. We had our organization meeting in Los Angeles in January. We received two invitations to come to Riverside. The first of these was from the Southern Sierras Power Company through its vice-president and general manager, Mr. A. B. West. As a fitting punishment to Mr. West and as a test of his loyalty to the organization we appointed him as chairman of the convention committee. You will see as the convention proceeds how right royally Mr. West has risen to his task.

Riverside is an ideal convention city. It is noted throughout the world for its hospitality and its beauty. Riverside is a progressixe city in principle and performance. There were wonderful roads in this section of the country before the value of good roads throughout the State of California was known. We have in Riverside also one of these municipal electric systems we hear about occasionally. This system, however, was not built as a destroyer or to compete with an existing investment, but to fill a need for service where no service existed. I think it is quite a remarkable showing when we remember that for the past twenty-five years the city of Riverside and the power corporations of this vicinity have worked harmoniously together to give service to the citizens of this city.

CAPTAIN H. F. JACKSON, PRESIDENT PACIFIC COAST SECTION, N. E. L A.

Born in the Middle West, trained at West Point, tried by fire during the Spanish-American War in Cuba, experienced as acting chief engineer of the Seventh Army Corps, backed by twelve years of executive life in operating one of California's greatest hydroelectric utilities, Captain H. F. Jackson, the newly elected president of the Pacific Coast Section of N. E. L. A., presents an unusual dovetailing of the man and the place for the effective piloting of the great utility activity of the West through the present national crisis.

We are honored today by the presence of the Mayor of Riverside, and at this time I have very great pleasure in introducing to you the Hon. Oscar Ford, mayor of Riverside. (Applause).

Mayor Ford: Ladies and gentlemen and delegates to the Convention of the National Electric Light Association, Riverside feels highly honored in being the first place where your convention is held. We have known something of the members of your organization here. We have done business with them, as your president has said, for twenty-five years. The business and other relations which we have had with you people have been entirely satisfactory on the part of the city, and we hope they have been profitable on the part of the members of your association with whom we have done business.

As stated by your president, in the beginning, our plant was organized not to compete with any already existing plant, but to get light, which we much needed at that time. In the beginning we issued bonds for $20,000, thinking we were going to build an electric power plant or something of that kind, and after the money was obtaned it was found that we barely had enough funds to build a line up above Redlands in the mountains where there was a plant already established, and this was done. Afterwards it became necessary to put in a little steam plant as auxiliary to the power which we were getting from the old Redlands Electric Company, as I believe it was called in the beginning. Since that time we have added to our distributing system but have not added to the power plant whch we use only now in case of emergency.

The greatest thing in the world, of course, is the people in the world and the greatest people in the world are those who do things. I don't know of anything that anybody could do that would be of more importance or be of more benefit to the people with whom they do business than in bringing light and power into the communities for their benefit. The light which you furnish goes into every street and every residence and every public building in this city and, aside from whatever profit you make out of it, you are doing a great thing for this community and the community appreciates it.

We are very glad to have you here in convention and we hope that you will make yourselves at home; that you will feel that this city is your city for the time that you are here,

We hope that the light of your countenances will still continue to shine on us as in the past, and that the power which you furnish may be used for the mutual benefit of yourselves and our people. I might have said that many of the orange groves which are on the higher lines here are only possible through the advent of the power which we get here, the water being pumped onto the high hills, making these groves possible; and we hope that in a friendly way the warmth of your friendship may be ours for all time to come. I thank you, gentlemen. (Applause).

President Ballard: A second invitation we received to hold our first meeting in Riverside was from the Riverside Chamber of Commerce. We had expected today that the Chamber of Commerce would be represented, but, due to the pressure of work in connection with the state defense matters, that pleasure will not be ours. On behalf of the association there is no one better qualified to respond to the eloquent remarks of Mayor Ford of Riverside than our much beloved dean of the electric light industry on the Pacific Coast, and I take great honor and pleasure in introducing to you this gentleman. He needs no introduction at my hands. Mr. John A. Britton of San Francisco. (Applause).

Mr. Britton: Your honor, Mr. Chairman, and gentlemen, I feel within this sanctuary like quoting from the scriptures in order to start right. Usually we end with a benediction. I am going to begin with one, applicable not only to Riverside but to the entire southern part of the state.

My sermon is taken from the fourth chapter of the gospel of humanity, beginning at the first verse: "I was a stranger and ye took me in." Riverside in common with all Southern California, has taken us in, not in the sense that might be applied when a public utility man deals with a consumer but from a broader view. My objection as a member of the family living north of Tehachapi is that when Riverside and Southern California take people in they keep them too long. When they arrive up around the bay of San Francisco they are frazzled in body and purse and they are looking for the first train out to get back home.

But can you blame them? Hospitality in California is well known. It always begins with a capital letter. But here, amid these wonderful orange groves, these hills crowned with snow shining upon the vales and valleys below, rich in their verdure of green and all the colors of the spectrum, they spell hospitality with capital letters all the way through and they don't remind you of it. It is unostentatious.

You are taken unconsciously into their hearts and into their confidences,—particularly into their confidences when they tell you of this vast domain of wonderful growth and life of this wonderful production of fruits, flowers and sunshine. They confide that, not in a whisper but from the mountain tops and to all the world, and I care not where you go, whether in the plains of Africa, the steppes of Russia, the fields of Italy or the tops of the Sierra Nevada Mountains, you will hear nothing but Southern California. And as I said a minute ago, it is deservedly so, because the word hospitality means all that is expressed in the lexicon and then some, and we of the north a little more cold blooded, perhaps, in our actions and demeanor, have many a good lesson to learn from these people in the south that have made of this arid desert, as it were, a garden of Eden here in California.

I want the honorable mayor to realize that as much as I esteem Riverside and the way it has been keeping out of the municipal plant game as it is usually played, that I want him to appreciate how it has been done and by what means and through what sources.

The industry which we represent, your honor, is an infant. It can be traced back in its early activities not over thirty years. There is hardly a man in the room today who was not born when electricity began to take this place among the sciences of the world. Nearly seventy-five years after gas had been discovered and put to practical uses and it was found that that good old illuminant could not do the things which in the progress of science and the advance of the nation it was needed to do, and there came men to the front who discovered that illuminant which we knew nothing about and that today is the power of the world for the good of all the world, because since the advent of electricity in its many phases, beginning with the telegraph, then the telephone, then lighting, and then its many uses for power, and then wireless telegraphy, and then wireless telephony, it has revolutionized the world and made possible the electrical industry. So today, placed as this nation is, it is better prepared to do its part in the defense of the nation than ever it was before in its history, and it is due to the growth and development of the science which these gentlemen so well represent.

Today, if by any catastrophe, if by any mistaken act of the government, the electric companies of this state particularly were deprived of their power to render service, chaos would come; destruction would come to this beautiful city,—because there is no state in the United States, no territory in all of Europe, that depends so much upon the uses of that subtle fluid that you control than does this state. If the power possibilities from the western slope of the Sierra Nevada Mountains could be taken off to some of the other states in the union, more congested in population, more good would result; but here, as it happens, no industry of any consequence, no government works, no coaling station, no city, no farm, but what is dependent first upon the falling waters of our streams and then upon the power created thereby.

This state has made its name and its mark through its men in the develpment and progress of this wonderful art of ours. In amount of kilowatt hours consumed per inhabitant we stand first; in low cost of power, we stand first. That has been done by bone and sinew and the brains of men that are here today, your honor, for the purpose of giving to the public and to the state, and, if need be, to the nation a better service and a cheaper service.

This is a disinterested crowd of men excepting in the one thing that they are intent upon doing for the benefit of the people, from the operator in the station to the manufacturer who supplies the material; and we challenge any state to bring together a more representative crowd of men, men who are doing things. We lack in this world not the man who says things so much as the man who does things, who makes things and who makes them go. That is the type of men you have here. I venture this assertion: That in every one of the territories in which these men are engaged or employed, that if any public matter arises, they are the first men called into council by the municipality of the city or the nation to confer with upon matters of importance. And our councils in Washington are made up of technical men in our profession; our councils here in the same way. It is because these men are not laggards. They are men who are active, energetic, brainful and ready to give their might in the preservation of the nation if called upon so to do.

We thank you, Mr. Mayor, for your hospitable greeting. We will take advantage of it. There won't be a nook or corner of your town that we will not visit. And we ask you as a matter of caution, in closing, if you will be kind enough to advise the chief of police, if you have one, that the men who wear this badge are immune at this time from any sort of punishment, (laughter and applause). We can feel perfectly free now to accept the hospitality unreservedly, and you need not take your latch keys away with you unless you wish. I hope you will make occasion to visit the part of the state from which I hail. I hope you will bring with you that sunshine and hospitality for which you are noted. I can assure you if you do come we will try to return in part the splendid welcome you have given to us. (Applause.)

H. F. Jackson, vice-president, assumes the chair.

Vice-President Jackson: On behalf of the association it gives me pleasure to request your president to give you the benefit of a few remarks at this auspicious time.

President Ballard: Members of the association, it has always been customary in associations of this kind that the president shall make what is termed an address, and, following that custom, I have such a document with me. I will now deliver it to you, trusting that you will sit with what patience you can muster, through to the end.

(See page 353, Journal of Electricity, May 1, 1917.)

President Ballard re-assumes the chair.

President Ballard: We will now have reports from some of our officers. The secretary of our association has been on the job strenuously, day and night, ever since our organization meeting, and it is largely due to his efforts that we have reached the point of membership and organization which we find ourselves in today. We will be interested in hearing what our secretary has to say at this time, and I have great pleasure in presenting to you Mr. Halloran of San Francisco.

Report of the Secretary

To the President of the Pacific Coast Section, National Electric Light Association:

During the past three and one-half months the Pacific Coast Section has evolved from a brave idea to a virile reality. Starting on the 6th of last January with a membership of less than 300, on the 15th of April it boasts a membership of 1419.

In point of numbers as well as of area, the Pacific Coast Section is already the largest geographic section in the United States, notwithstanding the fact that its four states have the lowest density of population of any section in the National Association. This phenomenal growth has been due to the energetic and enthusiastic efforts of its officers and committees who have crowded into three months' time work that would ordinarily have occupied a year.

But mere numbers by no means represent the worth of the association. Equally remarkable are the papers and reports which have been prepared by the several committees for consideration at this, our first annual convention. These are without exception of the highest grade and should do much to bring about a better understanding and speedier soltuion of the engineering and commercial problems which are peculiar and common to this great territory. The convention papers were printed in the Journal of Electricity of April 15th, see page 15.

This section has been the first to give serious consideration to unifying the several branches which constitute the electrical industry. Originally a central station organization, it has been greatly broadened so as to include in its membership a large representation of the manufacturers, jobbers and contractor-dealers. Steps have been taken to give each of these interests adequate representation on the executive committee at this meeting and in the commercial committee's report especially are recommendations which should do much to advance the material prosperity of each sub-division.

It has been the privilege of your secretary during the past few weeks to personally visit the plants of nearly every one of the fifty class A members of the organization. In this way, it has been possible to learn the local conditions which each company has to meet and thus bring about a more intelligent conduct of the section's activities.

At this time it seems wise to suggest that inasmuch as the smaller companies outnumber the larger companies three to one, that particular attention be devoted to promoting the welfare of the smaller companies. They can learn much and profit greatly from the experience of the men in the larger companies.

With so much cause for congratulation, we should not overlook certain shortcomings which have yet to be corrected. The decentralization of the national organization is so recent that sufficient provision has not yet been made for carrying on the work connected with the geographic sections. The New York office of the association seems to have been swamped by the rapid accessions of membership from this section. At this time we have no adequate record regarding the payment of dues. Strenuous local efforts have been made to remedy this lack of information but until we have a fuller co-ordination of effort the Pacific Coast section's progress will be hampered.

It is advisable also that greater use be made of the secretary's office as a clearing house for ideas. Each member should freely contribute results of his experience for the benefit of others and feel free to ask any questions which will be published so that others may answer them. Special facilities are available through the association for the smaller companies to secure trained men from the larger organizations. The suggestion to this end and the report of the commercial committee should greatly enhance the value of the smaller companies' membership in the association.

The work of the technical and accounting committees has been directed mainly toward standardization of practice and toward unity of action as regards regulatory requirements. This work likewise should be in constant progress throughout the year and not confined merely to convention time. It is believed that the secretary's office in this case also can be of assistance to all members.

At this time your secretary cannot forbear from expressing his appreciation for the cordial spirit of co-operation which has existed throughout the organization. It has been a constant incentive to greater activity. Our work has had a most wonderful beginning and if the large attendance at this convention, nearly a quarter of our entire membership, is any index, the future is most promising.

President Ballard: I know that you will be interested in hearing from the treasurer how much we owe. (Laughter). And at this time I will ask our treasurer to make his report, and I present Mr. A. N. Kemp of the Pacific Light & Power Corporation of Los Angeles.

Treasurer reads his report as follows:

First Report of Treasurer Pacific Coast Section National Electric Light Association

Gentlemen: At the first meeting of your executive committee, a budget for the current fiscal year was authorized in a total of $1500. This was subscribed as follows:

Salaries	$1350
Traveling expenses	600
Stationery and printing	400
General expenses	300
Postage	300
Convention expenses	250
Engineering research	500
Contingent	300
	$4000

Of the above amount up to the present time there has been expended the sum of $1118.18, distributed over:

Salaries	$400.00
Traveling expenses	486.35
Stationery and printing	220.40
General expenses	40.19
Postage	28.60
	$1,175.54
Less credit for 2 scrip books	57.36
	$1118.18

As a temporary expedient to provide funds in advance of the receipt of moneys from the treasurer of the N. E. L. A., your executive committee decided at its meeting on January 6th, that the larger Class A members be permitted to advance the aggregate amount of $1500, subdivided as follows:

Great Western Power Company	$ 168.00
Los Angeles Gas & Electric Corporation	85.00
Pacific Gas & Electric Company	530.00
Pacific Light & Power Corporation	175.00
San Diego Consolidated Gas & Electric Co	56.00
San Joaquin Light & Power Corporation	98.00
Sierra & San Francisco Power Co	72.00
Southern California Edison Co	260.00
Western States Gas & Electric Co	56.00
	$1500.00

In addition to this amount there has been received from the National Electric Light Association the sum of $2000, making a total of $3500 received, which, less the above dis-

bursements of $1118.18, leaves a cash balance in the Security Trust & Savings Bank, Los Angeles, as per the attached certificate of $2381.82.

Our proportion of the dues of the members of this section at the present time amounts to $3006.25, made up as follows:

	Number	Total Dues	Proportion to Pacific Coast Section
Class A....	51	$735.00	$ 362.50
Class B....	1237	6185.00	2171.25
Class C....	4	20.00	......
Class D....	34	790.00	395.00
Class E....	62	310.00	77.50
	1388		$3006.25

Of this amount, as stated above, we have already received $2000 on account, leaving still due $1006.25, so that the actual cash condition to meet the requirements of the authorized budget will be:

Advanced by member companies	$1500.00
Received on account from the N. E. L. A.	2000.00
Balance due from the N. E. L. A.	1006.25
	$4506.25
Less 1917 budget	4000.00
Cash balance	$ 506.25
It will be noted that the refunding of the $1500 advanced by Class A members would leave a deficit of	$ 993.75

In the event that your officers are successful in having the N. E. L. A., amend its constitution so as to permit of the remittance of 50 per cent of all Class B and E dues instead of 50 per cent for only the first 500 and 25 per cent on the remainder, our annual receipts will be increased on the basis of the present membership by $998.75 to a total of $4005.00 which is sufficient to meet the budget as set forth above.

Mr. Britton: I move you that the address of the president as read be received and referred to a committee of three for the return of such suggestions as occur to them in the re-reading of the report.

President Ballard: I will ask Vice-President Jackson to handle that motion.

(Vice-President Jackson thereupon puts the motion which has been seconded, and the motion is carried).

President Ballard: Our next order of business is the report of the membership committee. We had expected that Mr. W. W. Briggs of San Francisco, chairman of the committee, would be with us today, but he has been unavoidably detained. I will ask Mr. Kahn of Stockton, a member of this committee, to read the report of the membership committee.

Report of the Membership Committee, N.E.L.A.

Mr. R. H. Ballard, President Pacific Coast Section, N.E.L.A., Los Angeles, Cal.

Dear Sir: I am presenting herewith the report of the Membership Committee appointed to take care of development work for the increase of membership in the Pacific Coast Section of the National Electric Light Association. This committee is composed of the following gentlemen:

W. W. Briggs, Chairman, Gt. Western Power Co., San Francisco.
C. A. Luckenbach, Los Angeles Gas & Elec. Co., Los Angeles, Cal.
Samuel Kahn, Western States Gas & Elec. Co., Stockton, Cal.
L. F. Galbraith, Pacific Gas & Electric Co., San Francisco.
W. L. McKinley, Sierra & S. F. Power Co., San Francisco.
W. S. Coleman, Pacific Gas & Electric Co., San Francisco.
S. J. Lisberger, Pacific Gas & Electric Co., San Francisco.
W. F. Frost, Southern Cal. Edison Co., Los Angeles, Cal.
E. A. Quinn, San Joaquin Light & Power Co., Fresno, Cal.
Frank R. Russell, Tucson Gas & Elec. Lt. & P. Co., Tucson, Ariz.
J. B. Mechling, Nevada-California Pr. Co., Goldfield, Nevada.
Jas. A. Shepard, Deming Ice & Elec. Co., Deming, N. M.
R. C. Lane, Upper Verde Public Utilities Co., Clarkdale, Ariz.
Ross B. Mateer, Southern Sierra Power Co., Riverside, Cal.
B. G. McBride, Elko-Lamoille Power Co., Elko, Nevada.
R. S. Arthur, Douglas Traction & Light Co., Douglas, Ariz.
R. S. Masson, The Arizona Power Co., Los Angeles and Prescott.
R. E. Fisher, Pacific Gas & Electric Co., San Francisco.
Geo. B. Furness, Pacific Gas & Electric Co., San Francisco.

Your committee has received excellent assistance and cooperation from Mr. A. H. Halloran, secretary, Pacific Coast Section.

Owing to the fact that the committee had to be organized primarily by correspondence and that considerable delay was experienced in acquiring information as to the existing membership of the National Electric Light Association, in the different membership classifications, a large amount of valuable time was lost in getting our work under way.

We took up with the eastern office the question of getting literature, etc., to use in connection with the campaign for new members—particularly in Class B, but found that there was little or no material of this kind available. For that reason, Mr. Halloran, secretary of the Pacific Coast Section, produced a little folder which we provided the various committeemen and which explained the object of the association, the benefits that accrued to individual membership, etc. This folder was placed in circulation through the various committeemen, and I think I may safely state it has been productive of great benefits.

Practically all of the new applications that have been received have been forwarded to Mr. A. H. Halloran, the secretary, and there has not been sufficient time to completely check these with the older lists, which have just been received, to enable us to advise you definitely of the number of applications for membership which have been received. Then again, through a misunderstanding, some of the applications were forwarded direct to the New York office by our committeemen without being sent to Mr. Halloran, which has also caused some confusion in our records.

We are now negotiating with two sizeable companies for Class A membership, namely, the Vallejo Electric Light & Power Company, and the California Telephone & Light Company, who have not as yet, however, definitely forwarded their applications, although they are giving the matter serious consideration.

With the advent of these two latter companies into the Pacific Coast Section, I believe that we will have in our membership practically 100 per cent of the possible Class A members who derive some material benefit from the association. We are circularizing all of the smaller companies, asking them to join, but it is questionable whether those companies furnishing service in towns of a population less than 1500 would receive sufficient benefits from the association to make their candidacy worth the expenditure of much effort to secure.

The membership committee will continue its activities until such time as the incoming administration shall advise of the appointment of new committees, at which time we will be glad to forward to the new membership committee the files of correspondence which we have accumulated and which will be of assistance to them in carrying on this work.

Very truly yours,

W. W. BRIGGS,
Chairman Membership Committee.

President Ballard: Gentlemen, at this time I desire to appoint a committee on resolutions to report at the close of the business section tomorrow afternoon. There will be a number of resolutions which will be prepared for this convention to consider. As such committee I will appoint Mr. J. J. Scrugham of Reno, Nevada, W. P. Southard of Albuquerque, New Mexico, A. Emory Wishon of Fresno, California.

In connection with the program I wish to ask that all delegates and guests will thoroughly consider and appreciate the entertainment fixed for Saturday, and not be in a hurry to run home. The Saturday entertainment is going to be something very much worth while. It is being put on by the Southern Sierras Power Company, and a large part of the expense of entertainment is being paid by that company, I understand that Mr. West will be pleased if he has a large crowd to handle, and more pleased with a large crowd than with a small one.

We have with us a man of national importance on whom I shall call at this time for a few brief remarks. I refer to Mr. Muldaur, assistant secretary of the association at New York.

Mr. Muldaur: Mr. Chairman, and gentlemen of the Pacific Coast Section of the National Electric Light Association, your program is very full. Your time is brief. I have reduced to writing the few words that I have the privilege of saying to you.

Mr. President and Gentlemen of the Pacific Coast Section National Electric Light Association:

Your program is very full and your time limited. I have therefore arranged what I shall have the pleasure of saying to you, in a form that will have at least the merit of brevity.

First, and most important, it is my very agreeable duty to bring you the greetings and best wishes of the National Electric Light Association. President Wagner has instructed me to extend to you his deep regret at his inability to attend this convention in person, and his best wishes for a most successful meeting. He writes, further: "It is the desire of our administration, as representing the National Electric Light Association, to co-operate, as fully as possible, with other associations in the solution of problems affecting the electrical industry, and in all matters which we may have in common, and upon which for the benefit of the industry as a whole, we should be in accord."

The attitude of the national body, in its relations with other associations, is most concisely expressed in this message. The geographic sections perform a service to the electrical industry quite distinct from that of the national association; more intensive, more intimate in its character, and it goes without saying, that the splendid work accomplished by your members, even during the very short time your association has been in existence, is exceeded in value by none of your sister organizations:

While the geographic sections are performing this excellent work, it will not be forgotten that the national body exists for the purpose of bringing it all together in such manner that the accumulated experience of the entire country is instantly available to all its members. It is no small thing, that a problem arising on one coast may be identical with one already solved on the other, and that this fact may be learned by application to the New York headquarters. It it undoubtedly true that, as your secretary has pointed out, the membership of the association has increased out of proportion to the headquarters staff. For this reason, it is doubtless the case that desired information has not always been furnished as promptly as we could wish. It is also true, however, that this difficulty is rapidly being corrected, and I venture to say that there is not a question that can arise, from the most trivial to the highest technical application, that the national association, through its archives or its members, cannot answer. But it is essential that members should know and realize that this store-house is open to them, and should avail themselves of its contents. If the geographic organization is intensive, the national is extensive.

The National Electric Light Association takes the greatest pride in such success as yours, and appreciates to the full your loyal co-operation. It is its constant endeavor to increase the already close relations existing among the affiliated organizations, and in this it depends upon, and counts upon, your help.

Vice-President Jackson: I desire to announce the committee covered by the resolution presented by Mr. John A. Britton on the president's address. The committee will be Mr. T. E. Bibbons, chairman; Mr. Ed. Whaley and Mr. A. B. West.

President Ballard: We have now finished the schedule set for 10:30. We will now proceed with the balance of the program.

During the three or three and a half months of our existence we have had a number of committees working and working hard in preparation of papers and in making studies of the several subjects which will be discussed at the convention. It is my purpose that immediately following the presentation of a report of a committee by its chairman that the chairman of the committee shall preside over the meeting while the discussion is taking place and while the papers relating to his committee work are being presented.

Our first session will be the commercial session, which committee has been exceedingly active under the chairmanship of Mr. Stanley V. Walton of San Francisco, and I take great pleasure at this time in presenting to you Mr. Walton, who will present his report and be in charge of the meeting for the balance of the afternoon.

Mr. Britton: Before Mr. Walton takes charge of the meeting, I would request that the senior representative of every committee wait until after adjournment to discuss with me as chairman of the public policy committee a matter of vital interest, concerning which we must decide upon some policy before the end of the day.

ANNOUNCEMENT OF THE PIT RIVER DEVELOPMENT

Development of its water rights on the Pit River, in Shasta County, recently begun by the Pacific Gas & Electric Company, will enable the company to generate 180,000 horsepower of electrical energy, more than the combined capacity of its eleven power plants, which now generate 156,000 horsepower of electric energy.

The project will be completed in five years, at a cost of $17,500,000, and involves the diversion of the water of the Pit River at the Big Bend site, sixty miles northeast of Redding. From that point water will be conveyed through seven miles of tunnel and three quarters of a mile of open ditch to a site selected for the power house. The fall of water between the point of diversion and the point of use is 939 ft. With an average stream flow of 2400 cubic feet a second, development of a minimum of 180,000 horsepower will be possible.

The Pacific Gas & Electric Company purchased its water rights from the Mount Shasta Power Corporation, which began to develop the project in 1906. The water site is considered very good, because, from a drainage area of 4365 square miles, a constant process of underground water storage, due to lava formation, makes the supply vary little with the seasons. The State Water Commission in 1912 reported that 412,000 horsepower could be developed along the Pit River without storage.

From the power house in Shasta County the electricity will be transmitted by steel tower line across country to tie in with the company's other high tension lines to San Francisco bay. The current will be carried along the wires at a voltage of not less than 110,000.

Discussing the construction of the new plant and the development of the Pit River power, General Manager John A. Britton said recently:

"We calculate that this expenditure and its result will take care of our company's needs for from ten to fifteen years, at the present rate of our growth. The industrial feature of California's development is assuming larger proportions every day. This condition has been brought about by cheap electric power.

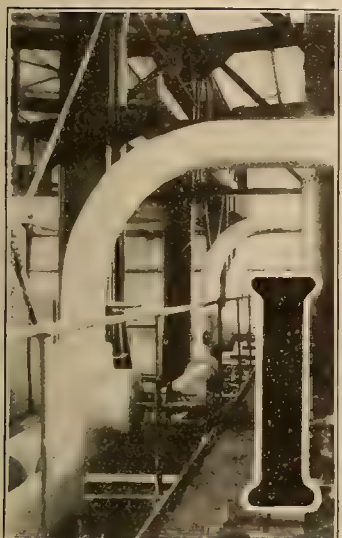
"The word has gone forth that every possible acre of land in California is to be made use of to meet the food situation, and here, too, electricity comes into play."

FUEL OIL AND STEAM ENGINEERING

(The different uses of wet saturated steam, dry saturated steam and steam that is superheated call for some standard to which boiler performance may be properly referred for comparative tests and performances. Equivalent evaporation and factor of evaporation are necessary working tools to accomplish this result. In this article the author first defines these quantities and then proceeds to methods of computing them for the three qualities of steam referred to. He then concludes with an example of how to compute the boiler horsepower when these factors are known.—The Editor.)

EQUIVALENT EVAPORATION AND FACTOR OF EVAPORATION IN FUEL OIL PRACTICE

BY ROBERT SIBLEY



Piping in Boiler Setting where Superheat Temperatures are Taken

IN the previous chapter it was seen that as the fundamental definition of the boiler horsepower is based upon a fictitious boiler that receives its feed water at 212° F. and then evaporates it into dry saturated steam at 212° F. and atmospheric pressure, we must now develop some factor by which we can reduce boiler performances as actually met with in practice to this fictitious standard.

In order also to compare the steaming qualities of two different boilers or indeed to compare the same boiler under different conditions of water supply and steam generation, it is necessary that some standard of comparison be adopted. Thus a boiler under its normal condition of operation may be found to evaporate 1361 lb. of water per lb. of oil fired per hour when taking its feed water at 169.1° F. and converting it into superheated steam at a temperature of 527° F. and a pressure of 185.3 gauge. On the other hand, the identical boiler, when steaming under overload conditions of a feed-water temperature of 174.1° F., a superheat temperature of 536.9° F. and gauge pressure of 194.1 lb. per square inch may be found to evaporate only 13.17 lb. of water per lb. of oil fired, even though the same quality of oil be used in each instance. It is evident then from sight that to compare these two evaporative quantities without taking account of the actual heat transferred from the fuel to the steam in the boiler would be a possible source of error.

The Standard that Has Been Adopted.—To avoid inconsistencies and to develop some rational method of comparison, engineers have found it convenient and accurate to reduce all evaporative quantities of a boiler to a definite standard. In order to follow out this standardized comparison, all steam generating performances of boilers read as if the boiler took its feed water at 212° F. and atmospheric pressure, and converted it into dry saturated steam at 212° F. and atmospheric pressure, as set forth in the standard definition of the boiler horsepower in the last chapter. It is clearly evident that no such theoretical boiler has ever existed, yet this standard of comparison is found very convenient. Thus in any case of boiler performance, if M_e represents such an equivalent or comparative standardized evaporation in lbs. of water per lb. of fuel, and M_w the lb. of water actually evaporated in the boiler under conditions of test, we may now invent a factor to be known as the factor of evaporation, F_e, whereby such performances may be readily reduced:

$$M_e = M_w . F_e \qquad (1)$$

In the same way, the equivalent evaporation of water per hour may be computed from the formula

$$M_{eh} = M_{wh} . F_e \qquad (2)$$

wherein M_{eh} and M_{wh} represent hourly conditions of evaporation.

Let us next analyze the factor of evaporation and see how we may actually compute its value for any given case. We have previously found that in the operation of the boiler, steam appears in three different conditions or qualities, namely in what is known as dry saturated, wet saturated, or super-heated steam. Let us then consider the evaluation of the factor of evaporation for these three distinct instances.

Dry Saturated Steam.—In the case of dry saturated steam, the water enters the boiler already possessing a heat of liquid h_f corresponding to its entrance temperature which may be readily found in the steam tables. This water is next converted into dry saturated steam which has a total heat (H_e) corresponding to the pressure at which the evaporation takes place. Consequently the actual heat which has been transferred from the boiler shell to the water is ($H_e - h_f$) heat units. But to evaporate one pound of water at 212° F. into dry steam at 212° F. requires 970.4 heat units. Hence if M_w pounds of water are evaporated under test conditions, the number of pounds M_e under standardized conditions would evidently be $M_w \dfrac{(H_e - h_f)}{970.4}$. Therefore, for dry saturated steam

$$F_e \text{ (dry saturated steam)} = \frac{(H_e - h_f)}{970.4} \qquad (3)$$

Thus in the case of a boiler which takes its feed water at 101.8° and converts it into dry saturated steam at 180 lb. pressure per square inch, from the steam tables we find that H_e is 1196.4 and h_f is 69.8, hence the factor of evaporation is

$$F_e = \frac{1196.4 - 69.8}{970.4} = 1.16$$

Wet Saturated Steam.—In the case of wet saturated steam all of the water entering the boiler is not converted into steam. As a consequence a certain portion of heat $(h_e - h_f)$ is required to raise the temperature of the water from entrance temperature t_f to the temperature of evaporation t_e and if only x_e parts of a lb. are then evaporated into steam, only XL_e B.t.u. are required to accomplish this result. Hence, the total heat required per lb. of water so evaporated is $(h_e + X_e L_e - h_f)$.

As a consequence the factor of evaporation in this case may from similar reasoning be expressed by the formula (wet saturated steam)

$$F_e = \frac{(h_e + X_e L_e - h_f)}{970.4} \qquad \ldots\ldots\ldots\ldots (4)$$

As an instance showing the application of this formula let us assume that the boiler above mentioned did not evaporate the water into dry steam but that upon investigation it was found to contain 5 per cent moisture. What now is its factor of evaporation? From the steam tables we find that h_e is 345.6, L_e is 850.8 and h_f is 69.8. Therefore the factor of evaporation is

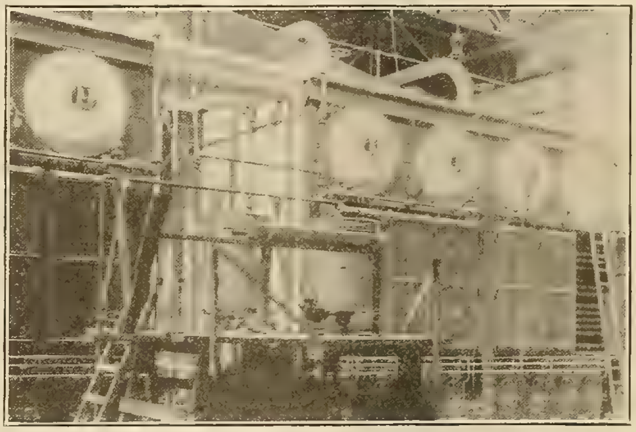
$$F_e = \frac{345.6 + .95 \times 850.8}{970.4} = 1.117$$

Superheated Steam.—In the third instance steam is not only evaporated to a dry saturated condition, but is finally sent from the boiler in a superheated condition. The steam tables are so arranged that we may find the heat necessary to raise the total heat of superheated steam when its pressure and temperature are known. Considering that the water entered the boiler at 32° F., let us then call H_s the total heat of superheated steam Since now the water entered the boiler with a heat of liquid equal to h_f the actual heat entering each lb. of steam evaporated in the boiler under these conditions is $(H_s - h_f)$ heat units. Hence in this instance the factor of evaporation is likewise from similar reasoning computed by the formula: (superheated steam)

$$F_e = \frac{H_s - h_f}{970.4} \qquad \ldots\ldots\ldots\ldots (5)$$

To follow up the same example as set forth in the preceding illustration, let us assume that the steam is evaporated under the conditions hitherto mentioned, but that it appears superheated to the extent of 100°. Looking in the steam tables we find that the total heat H_s of superheated steam at 180 lb. pressure and 100° superheat is 1254.3 and that the heat of liquid h_f is 69.8, consequently the factor of evaporation is

$$F_e = \frac{1254.3 - 69.8}{970.4} = 1.22$$



Platform Scales and Tanks for Water Measurement

The boiler immediately to the right of the platform scales is under test. The tank below the platform scales into which the water is emptied after being weighed, is utilized to furnish all water for the boiler during the test. At the beginning of the test a hooked gauge registers the height of the water in this tank, and at each hourly period thereafter sufficient water is weighed and emptied into it from the tanks above to maintain this exact level. By means of these data, properly taken, the factor of evaporation and the boiler horsepower are easily computed.

To Compute the Boiler Horsepower.—Since now by means of formula (57), we are enabled to compute the equivalent evaporation M_{wh} in pounds of water per hour that the boiler under test would evaporate were it taking its feed water at 212° F. and converting it into dry saturated steam at the same temperature, we can at once compute the horsepower of the boiler. Under such conditions of operation for every 34.5 lb. of water evaporated per hour, the boiler is developing one boiler horsepower. Hence to compute the boiler horsepower, we write the formula:

$$\text{Bl. hp.} = \frac{M_{wh}}{34.5} \qquad \ldots\ldots\ldots\ldots (6)$$

Thus if a boiler has an equivalent evaporation of 23,350 lb. of water per hour, its horsepower is found to be

$$\text{Bl.h.p.} = \frac{23{,}350}{34.5} = 676.7$$

We could of course develop an expression for the computation of boiler horsepower by taking into consideration the heat absorbed by the generation of steam per hour. For in our discussion in the previous chapter it was shown that one boiler horsepower is equivalent to the absorption of 33,479 heat units per hour. Hence, by computing the heat absorbed by the total pounds of steam generated per hour and dividing this by 33,479, we can compute boiler horsepower and arrive at the same answer as given in the above formula. It is better, however, for the beginner to follow fundamental definitions rather than attempt too many short cuts to gain quick results.

In conclusion the important relationship to bear in mind is the vast difference between the socalled mechanical horsepower and the boiler horsepower which was brought out in the previous discussion. With this relationship firmly fixed it must be remembered that equivalent evaporation is such an evaporation as would be brought about by taking in water into the boilers at 212° F. and evaporating it into dry saturated steam at 212° F. and atmospheric pressure. The formulas deduced above for equivalent evaporation and factor of evaporation enable us to do this.

SPARKS—Current Facts, Figures and Fancy

(The recent trend of events has necessitated the deepest thought and attention of utility companies throughout the West looking toward forwarding the production of agriculture and the consequent increased use of electrical energy. Below will be found an interesting and profitable item on how potatoes are preserved over long periods of time in Bolivia that might receive application in sections of the West. Other items that may serve in giving you a new thought or further inspiration for work may be gleaned from the following notations.—The Editor.)

Balsa wood, found in Central America, is said to be the lightest known wood. It is lighter than cork and has an average specific gravity of only .104.

* * *

A wood specimen found in glacial drift and estimated by the Wisconsin State Geologist to be approximately half a million years old has been identified by the Forest Products Laboratory of the Forest Service as spruce.

* * *

Nearly forty billion feet of timber was cut in 1916 in the United States. The State of Washington was again the largest producer with four and one-half billion feet, Louisiana being second with about four billion and a quarter feet.

* * *

It was the unanimous opinion of the National Chamber Committee which met in Washington recently that employers should await the result of legislation now pending in congress before making arrangements for the dependents of employes who enlist.

* * *

More than twenty million dollars will probably be spent in the next ten years in building good roads in the National Forests. What this will mean to the farmers and settlers living in and near the Forests and to the vast number of other Americans who may wish to use them as places in which to find health, rest, and recreation can scarcely be realized.

* * *

A new step in railroad service has been taken by the Southern Pacific Company in the establishment in the larger cities along the coast of a ticket delivery system. Hereafter, the busy housewife or the harassed man of affairs can telephone for tickets, Pullman reservations or scrip books, and have them delivered to home or office by special messenger.

* * *

An electric tractor, believed to be the first in California, built by the Agricultural Engineering Division of the University of California, was exhibited on Picnic Day, Saturday, April 28, at the University Farm at Davis. This electric tractor, which has proved very satisfactory in the preliminary trials, is not meant for heavy work, but to replace hand labor. While still in the developmental stage, it has proved that it can be run economically.

* * *

There is a great industrial awakening in Russia in the building of railways. The contemplated railway connection between India and Europe through the Hindu Kush will make the mail time between London and Delhi six days instead of the seventeen days required by the sea route via the Suez Canal. The cost of the passenger trip by railroad to India would probably be only about half as great as by the present roundabout steamship service.

* * *

New studies are constantly necessary for the engineer intending to engage in foreign service. For instance in the purchase of machinery intended for use in Oriental countries such as the Port of Aden and vicinity an important consideration is the quantity of gritty dust or sand which the strong winds prevailing at certain seasons of the year carry on and into everything. All machinery for this market should be as nearly dust or sand proof as possible. Further, the climate of Aden quickly affects all metal parts susceptible to rust, unless protected with particular care

* * *

In order to re-establish confidence in advertising the following are some violations in the new standard of ethics throughout the West: Questionable stock and bond issues, especially those from other states which get by the state commission on technicalities; unwarranted promises in land development; offers of something for nothing; misleading "help wanted" cards; "blind" classified advertisements; exaggerated untruthful statements; alleged "fire" and "bankruptcy" sales; patent medicine fakers; so-called painless dentists; Chinese doctors; men's diseases specialists.

* * *

Potatoes are cultivated throughout the Andean plateau in Bolivia at altitudes where even the hardiest grains and vegetables find life impossible. The natives have a method of preparing the potato so that it resists decomposition over long periods of time. By alternately freezing and thawing the tuber all the moisture is removed, and the resulting "chunu" (dried potato) can be stored for many months and even years without fear of its deteriorating. Pressed into little bullet-shaped units, "chunu" is on sale in every market on the Andean plateau and is a most important source of nourishment for the Indians.

* * *

The provincial government of Ontario, contemplates placing tractors at the disposal of farmers as a means of greater production. The government has about 35 district representatives in the more important agricultural counties of the province, and apparently intends to place a tractor at the disposal of each of these representatives, to be used in assisting the farmer to plow and prepare his land for the planting of crops. It is proposed to make a nominal charge per day or per acre and to keep the tractors going day and night. This is a suggestion that certain central stations of the West might perhaps note with profit.

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CONTENTS

THE TRIUMPH OF RIGHT

"But the right is more precious than peace, and we shall fight for the things which we have always carried nearest our hearts—for democracy, for the right of those who submit to authority to have a voice in their own governments, for the rights and liberties of small nations, for a universal dominion of right by such a concert of free peoples as shall bring peace and safety to all nations, and make the world itself at last free."

The N. E. L. A. Meeting in New York City

Electrical men of the West feel gratified to hear that their eastern brothers in the National Electric Light Association have held during the past week such a profitable meeting at New York City. Considerable dismay was at first felt throughout various sections of the West, after such a beautiful and enthusiastic meeting as that at Riverside, when the news came concerning the proposed abandonment of the annual convention of that organization at Atlantic City.

Later information developed the real reason for this abandonment to be due to the fact that the various member companies desired their men close at home during the present strenuous times. As these editorial sheets go to press the news that reaches us from New York City tells of the wonderfully effective work of the meeting held there during the past week. The remarkable patriotic fervor that was exhibited by the leaders of the electrical industry throughout the intensive section meetings that were held is a source of inspiration to the electrical industry the country over.

A New Means of Reaching the Investing Public

The present international crisis has not only brought out the fact that hydroelectric securities are to be considered of very desirable preference due to their ready acceptance as collateral for international financing, but the means that such organizations offer in reaching the investing public is another interesting and commendable feature of recent development.

One large hydroelectric company in the West has found a most convenient method of disposing of certain of its stocks and bonds on a very decidedly extended scale by dealing directly with its quarter of a million consumers through its own customers' mailing lists without the usual assistance of the bond broker. This has been proven so eminently satisfactory that Secretary McAdoo has had his attention called to it as a possibility of reaching with ease a most desirable class of the investing public for purchase of the present two billion dollar Liberty bond issue now being floated by the national government. This move on the part of public utilities of the West is not only a most patriotic and commendable one, but it shows, too, the helpful interrelationship that the modern utility company bears to the very heart throbs of the nation.

A Significant Announcement

The announcement by the Pacific Gas and Electric Company of its proposed new development of 180,000 horsepower of hydroelectric energy at the Big Bend site along the Pit River in Northern California will have a most marked effect in stabilizing national defense in so far as the Pacific Coast is concerned. Situated in a region of intense mineral wealth, generating in synchronism with its present eleven hydroelectric plants, this new project will add vastly to the present possibilities of munition and nitrate manufacturies in addition to providing an additional supply of energy for the future industrial and agricultural growth of the State.

As summarized elsewhere in this issue the new project will more than double the present installed hydroelectric output of this great high-tension distribution system, already the largest of its kind in the world.

The drainage area from which the Pit River draws its supply comprises 4365 square miles and is remarkable for its ability in equating the runoff throughout the different seasons of the year so that a minimum flow of 2400 cubic feet per second may be conservatively counted upon. By means of a seven-mile tunnel the water may be dropped 939 feet, thus developing the 180,000 horsepower above alluded to.

The investment of $17,500,000 required for this installation during the next five years will not only of itself materially forward financial and industrial activity throughout the West, but the new dollars set rolling in countless allied industries can hardly be overestimated.

An Opportnnity For Effective Service

To every thoughtful man there comes the question at this critical period, "What can I do personally to aid the national government or what influence for effective service can I exert at this present time for harmonious and unified action over business affairs under my personal control?"

To the man interested in hydroelectric activity this appeal comes with unusual emphasis. Upon the continuous operation and unhampered development of the great water powers of the West depend much for the operation of the industries, the mining of much needed metals, the production of agricultural products and the consequent safety of the nation.

At the recent Riverside convention of the Pacific Coast Section of the National Electric Light Association, the representatives of forty great central stations of the West, comprising an investment of a half billion dollars, unanimously offered service and system to the government to meet the exigencies of the present crisis.

The time is now ripe to make this beautiful offering of real concrete service to the nation. Let a movement be started at once to catalogue with definiteness the combined effectiveness this gift offers to the nation. Let their chemists report on the feasibility of nitrate manufacturies in various localities of the West. Let their electrical engineers advise as to proper proportionment of power for such nitrate and munition plants. Let the banker and financier be invited in to assist in securing additional funds for the immediate construction of such plants as may be reasonably built for manufacturing munitions and implements of war. Let the railway chiefs give of their experience and recommend ideas for improved traffic conditions, and finally let the agriculturist be called in to harmonize with such enlarged work in order to make the hydroelectric activities of the West of untold service to the nation and contribute their share to the war for world-wide democracy.

The tremendous advantage to the West of such industries immediately upon conclusion of the war in developing gigantic engineering trade relations with South America, Central America, Australia, China and Russia cannot be overestimated. But best of all for real concrete assistance to the government in the present state of affairs, no more beautiful and effective patriotic move could be made.

National Efficiency and the New Patriotism

The application of engineering efficiency study to the analysis of national effort brings to light many conclusions of utmost importance for the solution of the gigantic present-day problems immediately ahead of the nation.

The world conflict now upon us is admittedly one that will ultimately be decided by brains rather than brawn. All authorities agree that an appeal to the emotions solely is not sufficient to solve a weighty problem in analysis. To enter into the attempt to solve such a problem with enthusiasm aids much, but the all-conquering element of quiet, thoughtful reflection is the force that eventually carries the solution to a logical conclusion.

To properly and efficiently harness the working force of this nation will require the intelligent thought of every citizen—big and small, rich and poor—each synchronously performing the task to which he is best suited.

To send a volunteer force to Europe under the "hurrah and throwing of the hat enthusiasm" led by one of the greatest figures in modern public life of America would undoubtedly kindle a glow of patriotic fervor seldom realized in national life.

It would seem, however, that the advisability of this sending of volunteer troops to foreign lands as opposed to the selective idea should be weighed solely on its merits as to what best harmonizes with uniform activity of national strength. The old idea of volunteer and conscript has passed. A new patriotism is upon us. Ask any man in the street and you will fail to find any one but that is willing to make the sacrifice whatever that sacrifice may be, provided it is shown that the duty assigned him will bring about the most effective results for the nation as a whole.

And above all, efficiency study has taught us that the subjugation of selfish desire to the national good is the most effective way to produce results. In the present crisis there is no place for the big "I" of personal ambition. That which goes toward promoting the common welfare of the nation as a whole and mankind, in general, are the only considerations that should enter. This evident fervent spirit of patriotism manifested on all sides awaits but the selective call to the service required and the answer will be quick and effective. Such are the salient features of modern evolution in national efficiency and the new patriotism.

PERSONALS

W. F. Durand, professor of mechanical engineering at Leland Stanford Junior University, has been called to Washington to assist in advising the national government on the subject of aeronautics. Professor Durand has long been recognized as an eminent authority on many phases of mechanical engineering and this splendid possibility of effective contribution in the way of governmental engineering assistance comes as no surprise to close followers of his activities. The best wishes of engineers of the West go with him and they wish him god-speed in his new undertaking.

W. A. Thompson, general agent Federal Sign System (Electric) is at San Francisco from Boise, Idaho.

S. M. Kennedy, general agent of the Southern California Edison Company, is a recent San Francisco visitor.

T. W. Simpson, manager of the Federal Sign System (Electric) at San Francisco, spent the past week at Carmel, Cal.

C. E. Heise, manager of the Westinghouse Electric & Manufacturing Company at San Francisco, has returned from a trip to Honolulu.

H. W. Dryden, construction engineer in foreign department of General Electric Company, was at San Francisco during the past week on his way to Schenectady from India.

Arthur L. McLeod, manager of the Jeffery-Dewitt Company of Detroit, is a recent San Francisco visitor on his way East from a visit to many of the larger power companies of the Pacific Coast.

A. Emory Wishon, assistant general manager of the San Joaquin Light & Power Company, was a recent guest at the luncheon of the San Francisco Electrical Development & Jovian League at the Palace Hotel.

Max Loewenthal, general manager of the United Trading Company of San Francisco, has returned from a trip covering the coast territory, in the interest of the various firms which his company represents on the Pacific Coast.

H. B. Lane, formerly with the General Electric Company at Schenectady, has left for Shanghai, China, to be associated with Anderson, Meyer & Co., Ltd., in the capacity of commercial engineer. This company has the agency for the General Electric Company for the Republic of China.

A. H. Babcock, consulting electrical engineer Southern Pacific Company; **W. A. Cattell**, consulting civil engineer at San Francisco, and **D. P. Fullerton**, general superintendent Pacific Telephone & Telegraph Company, have received commissions as majors in the engineer officers' reserve corps.

Tracy Bibbins of the Pacific States Electric Company, **Samuel Taylor** of the Electric Railway Manufacturers' Supply Company, and **Albert Elliot**, secretary for the Pacific Coast Electrical Supply Jobbers' Association, have left for Hot Springs, Va., where they will attend the national convention of the Electrical Supply Jobbers' Association.

W. D'A. Ryan, the noted illumination engineer of the Panama-Pacific Exposition and of the Path of Gold in San Francisco, was recently presented with a beautiful loving cup through the San Francisco Call at the Downtown Association in the Colonial room of the St. Francis Hotel in appreciation of his wonderful contributions to the civic life of San Francisco.

Chas. J. Derleth, dean of the college of civil engineering at the University of California, will again resume his activities at the university with its opening of the Fall semester in August. Mr. Derleth, after a year's leave of absence from actual business life is feeling again his former grasp on life and is looking forward to the opening of college with much anticipation.

S. V. Mooney is president and treasurer, **B. L. Hodghead** vice-president, **K. G. Roebling** secretary, **I. J. Francis** general Coast sales agent, **S. W. Gilman** assistant secretary and manager San Francisco store, **J. N. Colkitt** manager Los Angeles store, **L. H. Parker** manager Portland store and **W. F. Richardson** manager Seattle store of the John A. Roebling's Sons Company of California.

George A. Schneider, power apparatus specialist for the Western Electric Company at San Francisco and a well-known departmental contributor to the columns of the Journal of Electricity, recently addressed members of the electrical club of the Oakland Chamber of Commerce on safeguarding the electrical worker in the discharge of his duty. In his address Mr. Schneider gave an outline of the safety devices which the law demands for the protection of electrical workers and the reasons which caused the enactments.

W. D. A. Peaslee, professor in electrical engineering at the Oregon Agricultural College, Corvallis, Ore.; **John Harisberger**, general superintendent light and power department Puget Sound Traction, Light & Power Company at Seattle; **A. R. Haynes**, chief operator White River generating station P. S. T., L. & P. Company, Dieringer, Wash.; **J. W. Swaren** of the Pelton Water Wheel Company at San Francisco, and **J. M. Morris** of the Westinghouse Electric & Manufacturing Company at Los Angeles, have received commissions as captains in the engineer officers' reserve corps and are now at the Presidio, San Francisco.

Chenry C. Bartlett, superintendent Corona Gas & Electric Company, Corona, Cal.; **Chas. H. Lee**, consulting civil engineer at Los Angeles; **Leslie W. Nims**, chief operator Utah Light & Traction Company, Salt Lake City, and **J. P. Growdon**, engineering department Northwestern Electric Company at Portland, have been commissioned as first lieutenants in the engineer officers' reserve corps and are now at the Presidio, San Francisco; **E. R. Perry**, commercial engineer Puget Sound Traction, Light & Power Company, Seattle, and **R. F. Dean** of the Pacific Power & Light Company at Pomeroy, Wash., are among the second lieutenants commissioned.

C. R. Young has been appointed sales manager of the Pacific Power & Light Company. Mr. Young has been with the Pacific company since 1911, acting in various capacities in the purchasing, operating and sales departments. He has also spent some time in the field. During the recent reorganization, at which time **Lewis A. McArthur** was made general manager, Mr. Young assumed the duties of sales manager but did not receive his actual appointment until a few days ago when public notice was sent out by the company. His headquarters are in the Spalding Building, Portland, Oregon. Mr. Young is a native of Eureka, Cal., and a graduate of Stanford University.

H. F. Jackson, president of the Sierra & San Francisco Power Company, and **J. E. Woodbridge**, resident engineer of Ford, Bacon & Davis, have returned to San Francisco from a visit through the Northwest. While at Spokane they purchased a 9000 kw. steam turbine from the Washington Water Power Company for installation in the North Beach plant of the Sierra & San Francisco Power Company. A conference was also held with representative men of the Northwest looking toward a closer co-ordination of the Northwest Electric Light and Power Association and the Pacific Coast Section, N. E. L. A.

MEETING NOTICES FOR ELECTRICAL MEN

(The most noteworthy meeting of men of the electrical industry during the past semi-monthly interval was that of the Pacific Coast Electrical Supply Jobbers' Association at Del Monte, California. The theme of discussion proved to be in the nature of an echo meeting of the Riverside convention described in the last issue of the Journal. This body of men is noted for its spirit of comradery and the good times and firm friendships formed at Del Monte have now become classic in the annals of the West. Other meetings of interest to men of the electrical industry are also described in the following pages.—The Editor.)

Pacific Coast Electrical Supply Jobbers' Association

The regular quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association was held at Del Monte, California, April 26-28, with a representative attendance of jobbers, manufacturers and central station men. Golf was, as usual, the all-absorbing avocation. The principal honors were carried off by T. E. Burger, who won the new Turner trophy for the first time and also the Pass & Seymour cup. Under the new system of handicapping on 72 par his score was 100 gross and 65 net. Ray Murphy was second with 122 gross and 70 net while C. C. Hillis, J. G. Pomeroy and E. J. Wallis tied for third place.

S. V. Walton by winning the central station cup for the third time secured it permanently with 111 gross and 71 net. The jobbers' copper cup and accompanying Del Monte trophy was won by C. C. Hillis with 88 gross and 71 net. The jobbers' cup for manufacturers' play was won by Miles F. Steel with a score of 112 gross and 70 net.

The chief topic for discussion at the general meeting on Saturday afternoon was A. W. Childs' paper on "Merchandising" as presented at the Riverside convention Pacific Coast Section N. E. L. A. A number of constructive suggestions were brought forth and should form the basis of definite action during the next few months.

Following the convention there was a district meeting of Western Electric Company managers and sales managers, including C. H. Talmage, the new manager at Salt Lake City, D. J. Butts of Los Angeles and Chas. Chestnut, the new sales manager at Seattle and Portland.

BUILDERS OF THE WEST—V

C. E. GRUNSKY

That an engineer of the West should have had a part in the building of the great Panama Canal is indeed a source of gratification to all well-wishers of the West. That noteworthy contributions to the technical press and to the transactions of distinguished engineering societies of America should be under the authorship of an engineer of the West is again in keeping with the best traditions of engineers of the West. But to C. E. Grunsky, as the courteous, hospitable leader in thought of commonwealth discussion this issue of the Journal is dedicated, since by the encouragement of such leadership the West may ultimately hope to take its place in world thought and activity.

San Francisco Electrical Development and Jovian League

Professor Ira W. Howerth, dean of the extension division of the University of California, was speaker for the noonday meeting of Wednesday, May 2, 1917. Mr. Howerth spoke in a most interesting and entertaining manner concerning the vast usefulness that this comparatively new effort to reach men of the electrical industry and other business activities of the West is accomplishing. Miles F. Steel, western manager of the Benjamin Electric Manufacturing Company, acted as chairman of the day. R. M. Alvord of the General Electric Company and president of the league, and Robert Sibley, editor of the Journal of Electricity, were presented with gold buttons for superior attendance at the league meetings.

W. W. Hanscom, a well-known consulting electrical engineer, and member of the league addressed the meeting May 9, 1917, on the subject of wireless telegraphy. Mr. Hanscom showed a wonderful grasp of his subject and described in interesting detail the modern accomplishments of this new art. Tracey W. Simpson of the Federal Sign System (Electric) acted as chairman of the day.

The Pacific Coast Gas Association

Attractive postal cards portraying the wonders of Santa Cruz are being sent out which read as follows: "Watch for announcement, Second "Get-Together" Dinner, Season 1917, Pacific Coast Gas Association, Los Angeles, Saturday, June 9, 1917. Twenty-fifth Convention, Santa Cruz, California, September 18 to 21, 1917."

The Oregon Society of Engineers

At the meeting of the Oregon Society of Engineers Saturday night, April 28, 1917, in the Oregon Building, the evening was devoted to a debate and discussion of the $6,000,000 road bond bill. O. Laurgaard presented the affirmative, while J. P. Newell gave the negative side.

Following the leaders, three minute discussions were allowed and among the speakers were E. J. Adams of the State Highway Commission, J. W. Cunningham, consulting engineer; John R. Penland, city engineer of Albany; Professor F. G. Young, head of the economics department of the University of Oregon; and J. D. Brown, president of the Farmers' Union.

The body unanimously adopted a motion authorizing President H. L. Vorse to appoint a committee of five engineers to compile statistics of the actual cost and life of different types of pavement. The committee is to co-operate with a similar committee from the Portland Realty Board.

Los Angeles Jovian Electric League

Harry N. Sessions, First Tribune of the Jovian Order, and first in the hearts of local Jovians, sustained his reputation as such at the meeting on April 25th, by putting over a splendid program, which was thoroughly enjoyed by the large number attending. Frederic T. Woodman, present mayor of Los Angeles, and candidate for re-election, was the principal speaker and talked on "Municipal Affairs." His platform and policies were outlined in a very interesting speech. Excellent entertainment features were introduced, including songs by the Lamp Socket Brigade of the Southern California Edison Company, the only quartet that carries its own scenery. Souvenirs were also distributed and a good time enjoyed by all.

The meeting of May 9th was conducted by Carl Young, second vice-president, in the absence of the president, A. E. Morphy. Harry C. Donoho, superintendent of the public employment bureau, the speaker of the day, talked on the subject of the Problem of Employment. Mr. Donoho outlined the work of the bureau, asserting that there is something decidedly wrong with the industrial organization of the country, and in a very entertaining and convincing way proved beyond a doubt the advantage to employers of using the municipal bureau in filling positions in their organizations. He stated that the Los Angeles Employment Bureau is beyond a doubt the largest organization of any private or public institution of its kind in the United States, having twenty-five clerks, three field agents, and filling forty-seven thousand positions within the last year. During the course of the program First Tribune Harry Sessions put some ginger into the proceedings with an impromptu rapid fire of witticisms and repartee which was very amusing and entertaining. W. C. Morrell of the Graham-Reynolds Electric Company, acted as chairman of the day and the music was furnished by the Cook Brothers.

Presentation of Edison Medal

The seventh Edison medal, which on December 13, 1916, was awarded to Mr. Nikola Tesla, "For meritorious achievements in his early original work in polyphase and high frequency electric currents," will be presented to Mr. Tesla at the annual meeting of the American Institute of Electrical Engineers in the Auditorium of the Engineering Societies Building, 29 West 39th street, New York, on Friday evening, May 18, 1917, at 8:30 p. m. Ladies are invited to attend this meeting. President H. W. Buck will preside, and addresses will be made by Dr. A. E. Kennelly, chairman of the Edison Medal Committee; Mr. Charles A. Terry of New York, and Mr. B. A. Behrend of Boston. The Edison medal was established upon the initiative of a group of friends and associates of Mr. Thomas A. Edison, for the purpose of recounting and celebrating the achievements of a quarter of a century in the art of electric lighting, with which the name of Edison is imperishably identified. It was decided that the most effective means of accomplishing this object would be by the establishment of a gold medal, which should, during the centuries to come, serve as an honorable incentive to scientists, engineers and artisans to maintain by their works a high standard of accomplishment. The Edison medal was, therefore, established and endowed with a trust fund, under an indenture dated February 11, 1904, whereby the American Institute of Electrical Engineers agreed to award the medal annually. The medal is awarded each year by a committee consisting of twenty-four members of the Institute, to a resident of the United States of America and its dependencies, or of the Dominion of Canada, "For Meritorious Achievement in Electrical Science or Electrical Engineering or the Electrical Arts."

UTILITY CO-OPERATION TO INCREASE PRODUCTION AND LOWER COSTS

BY ED WHALEY

(Broad gauge service to the nation is the keynote of the hour. Here is a most valuable suggestion from the newly-appointed general agent of the Northern California Power Company.—The Editor.)

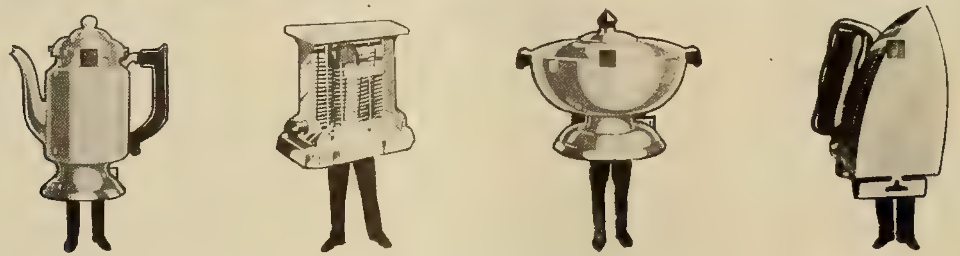
A number of the water companies of the State, with the able co-operation of the Railroad Commission, are taking steps to make their surplus water supplies available under emergency conditions for the duration of the war so that increased planting may be encouraged as an important step towards meeting a world shortage of foodstuffs. The irrigator depending upon an individual pumping plant operated either electrically or by gasoline engine can render an equal service if not a greater one as regards acreage affected by co-operating with his immediate neighbors by placing at their disposal his pumping plant for use at such times as he is not operating it, the operating costs, of course, to be divided between the users in proportion to the hours of use made by each.

Based on a six months irrigation season the average pumping plant in Northern California operates only about 15 per cent of the time. This would indicate that approximately six times the present acreage could be irrigated from these plants merely by an extension of ditches and a proper arrangement of crops. Practically, of course, such a result could not be expected as ample allowance would have to be made for additional seepage losses, character of crops, etc., but it is safe to say that by effective co-operation present installations could be made to serve 100 to 150 per cent additional land.

In the case of electrically operated plants operating under any block schedule of rates the additional hours of operation would bring the additional service under one of the lower steps of the rate so that the acreage cost per kilowatt hour and the power cost per acre irrigated would both be very materially lowered.

From an economic standpoint such action would be desirable at any time but it would be particularly advantageous in the present emergency because immediate results can be obtained, production can be increased and production costs automatically decreased, no additional investment is required and the details can be quickly worked out between each man and his neighbor where friendly intercourse and mutual helpfulness already exists.

A feature of the banquet at the Riverside convention of the Pacific Coast Section N. E. L. A. was the Lamp Socket Quartette, a clever conception by Walter L. Frost, assistant to the general agent of the Southern California Edison Company. The quartette was composed of H. S. Ross, M. MacNeil, C. H. Bishop, G. E. Armstrong and accompanied at the piano by Walter A. Linsdell. The singers



The Lamp Socket Quartette

Mr. Ross as "Percolator"; Mr. Armstrong as "Toaster"; Mr. Bishop as "Chafing Dish," and Mr. MacNeil as "Iron"

were made up to represent the electric percolator, toaster, chafing dish and electric iron and the song of "The Lamp Socket," written by C. H. Peirson at Mr. Frost's suggestion, to the tune of "When I Was a Lad" from the Opera "Pinafore," was rendered verse by verse in solo and the chorus by the quartette. The words to this song were published in the issue of the Journal for May 1, 1917.

A TRIBUTE FROM THE CONTRACTOR DEALER ON THE RIVERSIDE CONVENTION

BY C. F. BUTTE

(Many beautiful expressions and sentiments have been brought out in the various reports of the organizations and individuals that attended the remarkable gathering of the electrical fraternity at Riverside. Here is a part of the report of the members of the California Electrical Contractors' & Dealers' Association who attended this gathering, which should prove an inspiration to all men of the electrical industry in the West.—The Editor.)

Man is endogenous and education is his unfolding. We love to associate with heroic persons, since our receptivity is unlimited and with great men, our thoughts and manners easily become great. Great men of our industry are thus a collyrium to clear our eyes from egotism and enable us to see other people and men and their works.

We cannot even hear of personal vigor of any kind and great power of performances without fresh resolutions on our part. The opportunity of rubbing shoulders for several days at Riverside with men, versatile, eminent, men of an intuitive habit of thought, men who stand for facts and thoughts, has made us grow like the palm, from within outward. Men like John A. Britton, H. F. Jackson, R. H. Ballard, Samuel Kahn, Stanley Walton and others with whom we came in daily contact at the Riverside convention, inhabiting high spheres of thought have unfolded and aided us to discover the nature in us. What was thus learned was delightful in the doing and the effect remains.

It remains to unfold the many possibilities before us, it remains to encourage us to higher advantages, to urge us to extend the area of life, to impel us to greater activities, and to make us grow from within outward.

We admire great men of our industry, we applaud a sufficient man, we like a master standing firm on his legs, but we find him greater when he can abolish himself, as we found our dean of industry, John A. Britton, during our convention at Riverside.

The seed is planted, the energies directed into progressive channels, the activities formulated into systematic order at the several valuable meetings during our convention will spur us to greater endeavors and efforts to make the electrical industry as a whole a haven of content and admiration.

The discussion brought forth in the meetings proved of inestimable value to all present and has proven to us that general discussion on any subject by all allied interests brings us more firmly together, benefits all mutually and brings out facts that could not and would not be brought out by any one particular branch of the industry assembled individually.

The Riverside convention has conclusively shown that the central stations, the manufacturers, the jobbers and the contractor dealers have problems and conditions to work out to adjust and to arrange mutually to the benefit and advancement of the industry as a whole, and which could not be worked out, adjusted or arranged without collective meetings similar to the Riverside convention.

The central station has many problems to solve, as was shown at Riverside, that can be materially aided by the assistance of the allied interests. The manufacturer, the jobber and the contractor dealer also have many problems that must be solved by the aid of the respective allied interests.

The contractor dealer benefitted more directly than any other interest represented at the Riverside convention and it behooves the contractor dealer to strive to meet the situation. Strive to avail himself of the many advantages and opportunities now within his grasp, strive to grow from within outward.

The resolution adopted at this convention reading in part: The member companies of the Pacific Coast Section N. E. L. A. lend active co-operation and support to the California Association of Electrical Contractors and Dealers and that a proposed plan be formulated by the commercial committee "means much to the contractor dealer." Do all the contractor dealers realize or appreciate the extent and value of this portion of the resolution "active co-operation and support?" Do all the contractor dealers realize or appreciate the extent and value of this portion of the resolution "active?" Can any contractor dealer fully appreciate the co-operative spirit displayed in the adoption of this resolution by all members of the Pacific Coast N. E. L. A.? Members of the California Association of Electrical Contractors and Dealers let us individually and collectively show our spirit in the movement to affiliate all interests together by lending our efforts and endeavors to more closely cement and bind the co-operative inclinations displayed at the Riverside convention.

TECHNICAL MEN WANTED

Men skilled in civil engineering and similar occupations wanted in the Engineer Enlisted Reserve Corps of the United States Army for war service. Skilled laborers, mechanics and artisans, miners, surveyors, draftsmen, lithographers, boatmen, electricians, and others engaged in engineering or mchanical lines in civil life wanted for enlistment in the Engineer Reserve Corps of the U. S. Army. The War Department desires to secure immediately a large enrollment of enlisted men in this corps, and suitable men are urged to make application either by mail or in person to one of the following offices: District Engineer Officer, 204 Pine street, San Francisco, Cal.; District Engineer Officer, Thiid District, 405 Custom House, San Francisco, Cal.; District Engineer Officer, 723 Central Building, Los Angeles, Cal.; District Engineer Officer, 602 Burke Building, Seattle, Wash.; District Engineer Office, First District, 806 Couch Building, Portland, Ore.; District Engineer Officer, Second District, 321 Custom House, Portland, Ore.; Officer in Charge, U. S. Engineer Office, Yellowstone Park, Wyo.; Assistant Engineer, U. S. Engineer Sub-Office, Eureka, Cal.

MEMORANDUM ON LECTURE COURSE FOR ENGINEER OFFICERS' RESERVE CORPS

The sixth lecture in the lecture course to prepare civilians for examinations for a commission in all branches of the Officers' Reserve Corps, delivered at Native Sons of the Golden West Building, 430 Mason street, San Francisco, Cal., was given on April 17, 1917, by Captain John B. Murphy, Coast Artillery Corps, on the subject "Administration of the United States Army." This is a topic about which there is very little definite and readable information. Captain Murphy covered the paper work of the company administration, and all the essential chapters in the Army Regulations and Service Manuals that had a vital and definite bearing on army administration. It was one of the most interesting and comprehensive lectures of the course.

The seventh lecture of the series was delivered on April 24, 1917, by Captain Richard Park, Corps of Engineers, on the subject of "Topography." The general subject of military mapping was covered by way of introduction, and without attempting to teach those present how to make a military map, the main feature of road sketching and map reading were gone into in considerable detail—the work being illustrated by having an engineer sketching outfit set up on the stage and a small detachment of engineer soldiers going through the motions directing shots, reading angles, going in contours, taking side shots, and so on, each instrument used and each phase of the work being explained while the soldiers went through the motions.

The eighth lecture was given on May 1, 1917, on the subject of "Coast Artillery Drill Regulations."

LATEST IN EVERYTHING ELECTRICAL

(New uses for electrical energies are constantly being avolved. The recent advent of the electric linotype in battleship equipment has a two-fold meaning in these days of national stress. A brief description of this interesting application follows. Other recent mprovements in electrical devices may also be found in the following pages, which conclude with a book review and briefs concerning new bulletins of interest to men of the electrical industry throughout the West.—The Editor.)

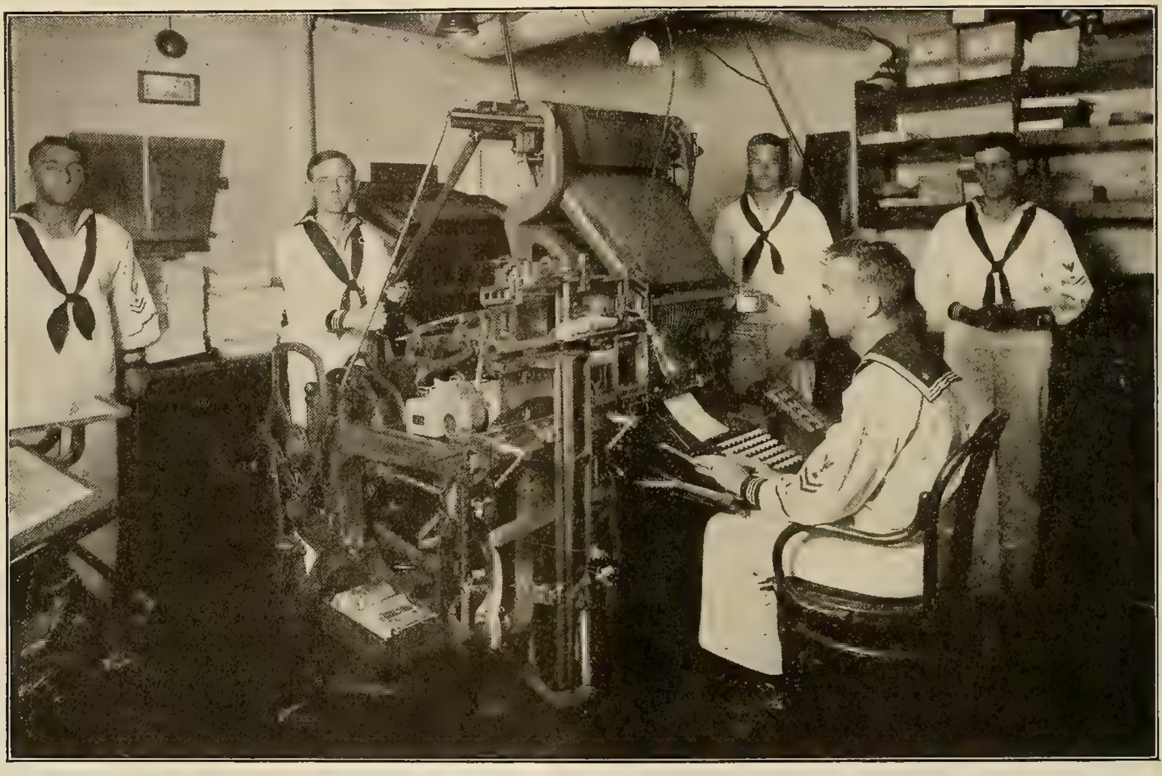
THE ELECTRIC LINOTYPE POT A GOOD CENTRAL STATION LOAD

Of the standard line of industrial heating devices, the electric linotype pot in particular has come into extensive use. There has existed of course for years back a desire to get away from the gas heated pot. Electric lighting companies, and printing and publishing houses both have investigated the electric pot. It furnishes a desirable load for the central station and is of good use to the printer because the automatic temperature regulation gives him better slugs and at the same time electric heat makes his rooms odorless. While the machine is in operation the current input is 600 watts and since these machines operate from 8 to 12 hours per day, a steady non-fluctuating load is the result and in many newspaper publishers' plants this load is between midnight and morning. When the metal is cold the input for about 50 minutes is about 1600 watts. It can readily be seen that a considerable yearly revenue is given the central station where even but a few of these electric pots are in service; as few as 20 furnishing a yearly load of over 50,000 kw.-hr.

There are many advantages peculiar to the electric principle of heating. It is primarily clean, safe, quick, economical and easily controlled, as there is an absence of open flames and the resultant products of combustion.

The bulb, the capillary tube, and operating coil are filled with mercury and sealed. The liquid expansion of the mercury causes the operating coil to move a lever to a contact, upon touching which the magnetic switch cuts off the current. As the temperature decreases the mercury contracts and the coil operating swings the lever back, closing the heating circuit. Thus, the heating current is automatically cut in and out, and the temperature of the metal held within twelve degrees above or below the mean operating point.

The New York World after a series of tests equipped their entire battery of fifty-six linotypes with the Cutler-Hammer pot. On the U. S. S. Wyoming a Mergenthaler linotype equipped with a C-H pot is installed and used in printing the Wyoming's monthly magazine, "The Coyote." A view of the printing office is shown in one of the illustrations.



"Doing it Electrically" on the U. S. S. Wyoming

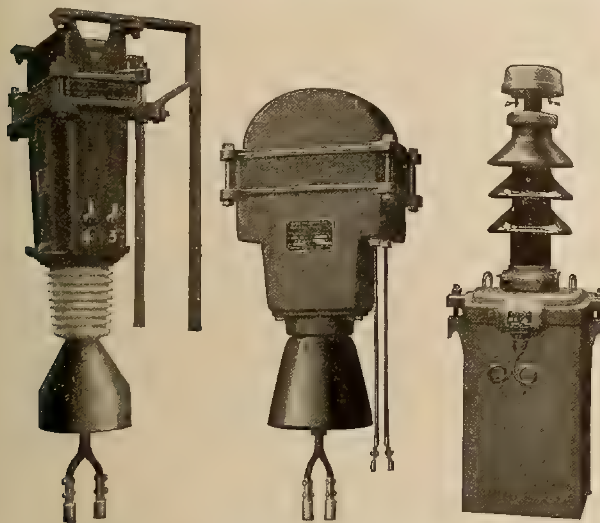
SAFETY TYPE LIGHTING PANELS

A new type of safety panel which is a distinct advance in the art of safeguarding electrical devices, even for the use of the most careless or inexperienced, has been perfected and placed on the market by the Sprague Electric Works of the General Electric Company. This panel is furnished in a steel cabinet usually having but one door. When this door is open it exposes a section showing the operating handles of branch circuit switches which are of 30 amps. 250 volts capacity, quick make and quick break tumbler type.

The "on" or "off" positions of the switch are indicated by the position of the switch handle and are marked on the handle mechanism so that "on" appears when the switch is on and "off" appears when the switch is off. This section also exposes the receptacles for plug fuses. Current carrying parts are protected under a neatly finished cover through which the switch handles and fuse receptacles protrude for operation.

OUTDOOR CURRENT TRANSFORMERS

Current transformers are employed for one or both of two purposes; to reduce the current to be measured to the relatively small values suitable for measuring instruments, relays, circuit breakers, and trip coils, or to insulate meter circuits from high line voltage. To meet the growing demand for such apparatus as a part of outdoor substation equipment, the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has developed and is marketing a



Improved Outdoor Current Transformers

complete line of outdoor current transformers for voltages up to and including 70,000 volts.

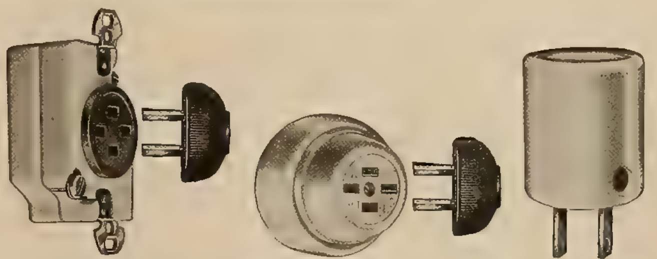
These outdoor current transformers are of two general types—dry and oil insulated. The dry type transformers are for use on circuits up to 24,000 volts. For circuits of higher voltages the oil insulated transformer is used. Both types are designed for use on from 25 to 133 cycle alternating current circuits and have a capacity rating of 50 volt amperes. They are compensated for 25 volt amperes. The dry type transformers are furnished in three styles and designated by type letters. Type MA is for voltages up to 8000, type MB for voltages of 17,000, and type MA for up to 24,000 volts. The oil insulated transformers are also furnished in three types; type OA for maximum voltages of 35,000; type OB for voltages of 47,000; and type OC for up to 70,000 volts. The primary amperage of the dry type transformers varies from 5 to 500 amperes, that of the oil insulated transformers from 5-10 to 200-400 amperes. All give a secondary amperage of 5.

NEW C-H "STANDARD" WIRING DEVICES

Six electrical manufacturers have agreed on the making of standard plugs and receptacles, the attaching caps of which can be connected to all the bodies of the several makes. In the accompanying illustrations are shown the C-H No. 7711

New "Standard" Wiring Devices

"Standard" single flush receptacle, C-H No. 7721 duplex flush receptacle, C-H No. 7717 surface receptacle, C-H No. 7750 cord connector and C-H No. 7755 motor attachment plug, all recently brought out by The Cutler-Hammer Manufacturing Company of Milwaukee. The single and duplex flush receptacles are small, of white porcelain and rated at 660 watts, 250 volts. The portions of the receptacles exposed through the apertures in the flush plates are black enameled, making a pleasing appearance and a surface which does not show soil. Each outlet is provided with four slots holding protected contacts; two parallel to receive the blades of the "standard" parallel blade cap or polarity cap—and two in tandem to receive the blades of the tandem blade cap. Terminal screws are large and easily accessible. The duplex receptacle is the same size as the single receptacle with double the number of outlets, allowing the attachment of two electrical appliances from one outlet box, and thus providing exceptional convenience and reducing the amount of wiring and installation expense. Large terminal screws are provided, one pair taking care of both receptacles. Grooves in the side of the porcelain body accommodate the conductors and prevent crowding in the outlet box.



New Parallel Blades and Attaching Caps

The surface receptacle, like the flush receptacles, is of glazed porcelain with concealed contacts and slots arranged to accommodate standard attaching caps. It is designed for concealed wiring and has the same rating as the other receptacles. A polarity cap with parallel blades, one enlarged to fit a correspondingly enlarged slot of the standard plugs and receptacles has also been recently brought out.

The "Standard" cord connector, C-H No. 7750, and motor attachment plug, C-H No 7755, are of the separable cap type, made entirely of Thermoplax, a black heat-resisting composition, and each is rated at 10 amperes, 250 volts. The cord connector accommodates the standard parallel blade, polarity blade or tandem blade attaching caps, and is provided with four slots holding protected contacts. The motor attachment plug uses the same body and is provided with a parallel blade cap arranged for mounting on the motor. The black Thermoplax compound, of which the devices are moulded, has excellent wearing qualities, and the appearance of the knurled cap is actually improved by wear.

C-H. No. 7708 parallel current tap is another device which The Cutler-Hammer Company has recently added to its standard line. It is made of white glazed porcelain and is provided with standard Edison lamp shell. Contact blades are parallel and designed for insertion in all the standard plugs and receptacles. The current is tapped through the side of the body and the device is rated at 660 watts, 250 volts.

CLEANING UP ADVERTISING

The Advertising Club of San Francisco is now appealing to the merchants and advertisers in this city to unite with it in an effort to clean up advertising. Technical observance of the law is not sufficient to completely increase public confidence in advertising, and as advertising men we recognize that we have no right to regulate the flagrant offender—the fly by night merchant—until we have placed our own business above criticism. For instance the publishing business would be a much more satisfactory business than now if the trade abuses could be stopped. Trade abuses, fraudulent methods of doing business and misrepresentation of all kinds, are things that come within the scope of the Better Advertising Committee of the San Francisco Advertising Club.

CROCKER-WHEELER MAKES RECORD QUARTER

The Crocker-Wheeler Company of Ampere, N. J., manufacturers of electrical machinery, made record earnings for the first quarter of 1917. The dividends on both classes of stock have been earned for the year and a substantial amount added to the surplus, which is now near the million mark. The preferred stock pays 7 per cent and the common 8 per cent regularly. The company has just paid an extra dividend of one per cent on the common stock. At the present rate, the profits, after paying dividends on the preferred stock would represent $44.17 per share for the year. The "book value" of the common stock on March 31, after setting aside the dividend for the preferred stock, which is callable at 108, is $151.43 per share. This company has been constantly and quietly increasing its equipment, which is reflected in its monthly statement.

BOOK REVIEW

Preliminary Mathematics. By Professor F. E. Austin, E. E.; size 4½ by 7½ in.; 169 pp.; cloth binding. Published by the author and for sale at the Technical Book Shop, San Francisco. Price $1.20.

While this book was designed originally for the use of those whose educational training had been limited it has been so remodelled as to adopt it for use of pupils attending the eighth grade and the high school, or the "Junior High School."

The book is to be taken as a connecting link between arithmetic and algebra. It is clear and simple in its presentation and should appeal generally to anyone interested in reviewing the subject.

The "Mechanical World" Electrical Pocket Book for 1917; size 4 by 6 in.; 300 pp.; 120 illustrations; cloth binding. Published by Emmott & Company of Manchester, England, and for sale at the Technical Book Shop in San Francisco. Price $0.45.

This book is a collection of electrical engineering notes, rules, tables and data. In addition it contains blank pages for a diary and memoranda for 1917. It contains discussions on electrical measurements and testing, transmission line calculations, wiring systems and methods, electricity meters, lighting circuits and switching, and electric lamp and electric lighting. For anyone desiring a booklet to give the English point of view on such discussions, the booklet will be found valuable.

Electrical Meters. By Cyril M. Jansky; size 6 by 9 in.; 416 pp.; 314 illustrations; cloth binding. Published by McGraw-Hill Book Company, Inc., and for sale at the Technical Book Shop, San Francisco. Price $3.00.

This book which has passed through its first edition has been prepared in the extension division of the University of Wisconsin. The many new developments in electrical meter design since the publication of the first edition has necessitated the omission of some and the addition of much new material in the revised edition. The book is highly practical. Only so much of the theory of instrument transformers and other discussions is given as is necessary for an understanding of their function in connection with meters and their testing. The book should continue to receive a welcome place among students of the grade encountered in university extension work.

Theory and Calculation of Electric Circuits. By C. P. Steinmetz; size 6 by 9 in.; 361 pp.; 133 illustrations; cloth binding. Published by McGraw-Hill Book Company and for sale at the Technical Book Shop, San Francisco. Price $3.00.

In some respects this work and its companion volume, "Theory and Calculation of Electrical Apparatus," may be considered as continuations or rather parts of "Theory and Calculation of Alternating Current Phenomena." Since the original appearance of Dr. Steinmetz' works some twenty years ago, the general theory of alternating current phenomena has so vastly expanded that three separate volumes are necessary in the new revision by the author which revision is now just off the press. In this book the author has discussed the most important characteristics of the fundamental conception of electrical engineering. His works, recognized for years as classics in electrical engineering need no further description, as they will find immediate demand in all quarters.

Wiring for Light and Power. By Terrell Croft; size 5 by 8 in.; 425 pp.; 382 illustrations; pliable binding. Published by the McGraw-Hill Book Company, Inc., of New York City and for sale at the Technical Book Shop, San Francisco. Price $2.00.

Almost anyone can install electrical wiring and apparatus so that they will work in some fashion or other. But to install them so that they will be electrically safe and mechanically secure involves the application of knowledge that has been gained accumulatively by hundreds of workers during many years of practice.

This book, which is written by a consulting engineer who is the author of "American Electricians' Handbook" and other writings, supplies explanations, elaborations and illustrations for those sections of the National Electrical Code to which it is necessary to refer most frequently. The book has incorporated in it, verbatim, the most important National-Electrical-Code regulations. Following these quotations the practical application in electrical construction is explained and fully illustrated by the author.

The mechanical make-up of the book is excellent, the type clear and the illustrations well selected. It should find immediate use in the wiring field.

NEW BULLETINS

The General Electric Company has issued bulletin 44406A on GE-247 Ventilated Commutating-Pole Railway Motor.

Westinghouse Arc Lamps and Lighting Systems is the subject matter of Catalogue 7-a, just issued, consisting of 108 pages.

The Bureau of Mines has recently issued Technical paper 82 on oxygen mine rescue apparatus and the physiological effects on users of this apparatus.

The Colorado School of Mines in its quarterly publication, presents an interesting and instructive article on the civic duties and opportunities of the engineer.

The General Electric Company in bulletins 40400A and 46208 set forth its belt-driven alternators, form PB and single-phase prepayment watthour meter type 1P-5.

The Doehler Die-Casting Company of Brooklyn, N. Y., has published a sixty page book beautifully illustrated on the subject of creating an industry in the art of casting metals.

The report of the State Water Commission of California recently issued contains much interesting information relative to the use of water in that commonwealth of value both to central stations and irrigationists.

Theodore P. Shouts is distributing complimentary copies of an illustrated booklet entitled "How a Twenty Million Dollar Railroad Was Built in Mid Air" in which he recounts the building of the third tracking of the New York "L."

The California Railroad Commission asks the co-operation of the public for further effective work in its excellent bulletin recently issued on the progress of the commission's investigation of railroad grade crossings in the state of California.

"A Preliminary Study of the Alloys of Chromium, Copper and Nickel," is the title of Bulletin No. 93 just issued by the experiment station of the University of Illinois. The investigation deals especially with the growing interest in acid-resisting alloys.

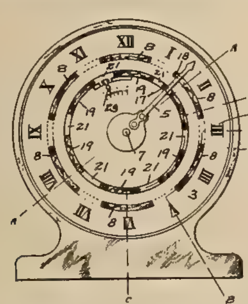
Industrial Heating as a Central Station Load which in its Part I deals with electric furnaces is an excellent booklet of thirty-two pages just published by the Society for Electrical Development, Inc., to assist central stations in building up additional profitable loads.

WHAT WESTERN INVENTORS ARE DOING

(The internal combustion engine has for half a century received the thought and attention of engineers and inventors the world over, the rapid rise of the Diesel engine being a forceful instance of this. On this page will be found a brief description of a rotary internal combustion engine recently invented by a Wetsern investigator. Other inventions by men throughout various sections of the West may also be found below.—The Editor.)

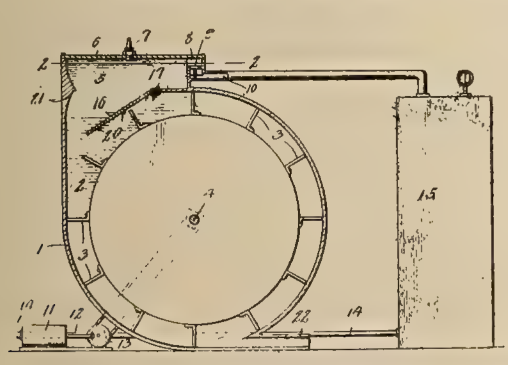
1,215,592. **Electric Controller.** Clarence Dale Vest, Martinez, Cal., assignor of one-half to Frederick A. Young, Martinez, Cal.

An electric controller comprising a dial of insulating material, a hand overlying the dial, clock mechanism for rotating the hand, a series of contacts on the dial arranged concentrically with respect to the center of rotation of the hand, a second series of contacts arranged concentrically with respect to the first-named series and movable circularly with relation thereto, an open electric circuit connected to the two series of contacts and means on the hand adapted to close the circuit.



1,216,184. **Rotary Internal-Combustion Engine.** Shelby P. Tierney, Metcalf, Ariz.

A rotary internal combustion engine embodying, in combination, a rotor provided with blades on its periphery, a stationary rotor casing, an explosion chamber arranged to discharge into the rotor casing tangentially of the rotor, a hinged valve separating the rotor casing from the explosion chamber, a valve stem bearing a fixed relation to said valve and extending through a wall of the explosion chamber, an ignition circuit-closing arm fast on said valve stem, a circuit contact in the path of said arm, and means for holding said valve closed wth a predetermined pressure.

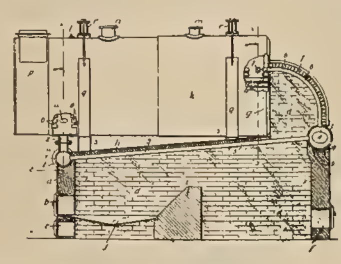


1,215,483. **Two-Cycle Internal-Combustion Engine.** Sylvester Charles, San Jose, Cal.

An internal combustion engine, a pair of oppositely moving pistons, between which the explosive mixture is compressed and fired, a cylinder in which the pistons are disposed, the cylinder having an open end disposed in a plane at right angles to its axis and formed with an annular groove, the cylinder also having a number of circumferentially spaced intake ports leading from the groove, and a cylinder head secured in contact with the end of the cylinder and having an annular groove registering with the aforesaid groove and forming therewith a fuel heating channel, the head also having an annular fuel heating reservoir with a fuel inlet, and a plurality of circumferentially spaced ports leading from the reservoir into the channel.

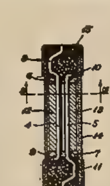
1,221,028. **Steam-Boiler.** Mark R. Colby, Portland, Ore.

A boiler of the type described having an upper fire-tube section, the combination with the fire-tube section of a lower water-tube section comprising a transversely disposed drum located beneath the front end of the fire-tube section and spaced therefrom, a drum located at the rear end of the fire-tube section, the drums having greater length than the diameter of the fire tube section, the lower water tube section connecting the drums along their full length and extending longitudinally beneath the fire-tube section; a connection between the lower portion of the fire-tube section and the forward drum, extension headers projecting laterally from the rear end of the fire-tube section and being in direct communication therewith, and arched water tubes connecting said rear drum with the fire-tube section approximately at the plane of the upper row of the fire tubes, the outer of the arched water tubes connecting with the extension headers.



1,221,232. **Automatic Cut-Out.** Joseph M. Sherman, Seattle, Wash.

The combination with an inclosing case made of material that is a non-conductor of electricity and having end walls of metal, of two plates of electrical insulating material transversely disposed within the inclosing case and spaced from each other, the plates being provided each with two correspondingly spaced holes extending therethrough; two pieces of metal wire disposed to extend between the plates in lines parallel with, and spaced from, each other with their opposite end portions projected through respective ones of the holes of the adjacent one of the plates, one end portion of one of the wires being etxended to and connected with the adjacent one of the end walls and one end portion of the other of the wires being extended to and connected with the other of the end walls; and two separated masses of metal disposed within the inclosing case between the plates, each of the masses being in metallic connection with a different one of the wires; and the metal of the masses being of a character to be fusible at a low temperature.



NEW ELECTRICAL DEVELOPMENTS

(The establishment of plants for the fixation of atmospheric nitrogen has long been the dream of all interested in agricultural and industrial development of the West. The present necessity of this product for munitions of war makes this need of unusual emphasis. The announcement of the Pacific Gas and Electric Company concerning its Pit River development of an additional 180,000 horsepower together with the recent agitation to locate a nitrate plant along the Los Angeles aqueduct and utilize the power thus generated for such a purpose as that above alluded to constitutes the most interesting new electrical development of the past semi-monthly period. Other items of interest in new electrical development throughout the West may also be gleaned from the following lines.—The Editor.)

FINANCIAL

STOCKTON, CAL.—The highest price ever obtained by the South San Joaquin irrigation district for its bonds was secured when the remaining issue of $114,500 was sold to the San Joaquin Valley National Bank of Stockton for $0.97801 on the dollar. The highest price formerly obtained was $0.844.

SAN FRANCISCO, CAL.—The second mortgage 6 per cent bonds of the Petaluma & Santa Rosa Railway Company, which were due recently, after having been extended from April 1, 1915, by agreement at that date, will be cared for, according to E. H. Rollins & Sons, fiscal agents. Difficulties in meeting sinking fund provisions of the first mortgage bonds will be adjusted by getting the bondholders to waive past default, expressly on condition that provision for the release and satisfaction of the second mortgage bonds shall be made by or before March 1, 1918.

ILLUMINATION

SAN LEANDRO, CAL.—The contract for the installation of electroliers in connection with the new lighting system on East Fourteenth street has been awarded to D. A. Cantin, of Los Angeles, who bid $1908.

EAGLE ROCK, CAL.—The city engineer has been instructed to make a survey of all streets running north and south from Colorado boulevard to Hill avenue, preliminary to installation of ornamental lighting posts.

SEATTLE, WASH.—The Arrow Electric Company has been awarded the contract for the furnishing and installation of the necessary electric wiring for the power and lighting system in the new building for the Northwest Dairy Company.

OTHELLO, WASH.—At a special election of the council last night it was decided to equip a municipally-owned electric lighting plant and make necessary improvements. The cost is estimated at $14,000, which will be secured from the sale of bonds.

DOUGLAS, ARIZ.—Within five or six weeks this city will have a street lighting system, according to the statement of R. W. Arthur of the Douglas Traction & Light Company. This company has been awarded a contract for lighting G avenue.

ARCADIA, CAL.—The board of trustees has awarded the contract for the installation of 29 reinforced concrete ornamental street lighting standards, together with appurtenances, on First avenue to the Southern California Edison Company on its bids of $1400.

LOS ANGELES, CAL.—An ordinance has been passed by the city council for the improvement of Wilshire boulevard from Park View street to Arden boulevard and Park View street from Sixth to Seventh streets, by the installation of necessary appliances and furnishing of electric current.

LOS ANGELES, CAL.—The city council has ordered the necessary ornamental lighting posts and appliances to be installed and maintained and electric current to be furnished for a period of one year for the lighting of Sierra Bonita avenue between Hawthorne avenue and Sunset boulevard.

LOS ANGELES, CAL.—The federal government is seeking the use of electricity generated at Aqueduct Station No. 1 for a big nitric acid plant it is planned to start here. Petitions asking the council to tender the government of the United States the electric energy have been presented.

PASADENA, CAL.—Resolutions have been adopted by the city commissioners for the construction and installation of posts, conduits, wires, lamps and other suitable and necessary appliances in Lester avenue, between Orange Grove avenue, and Rosella Drive, together with feeder wires.

LOS ANGELES, CAL.—The city council has passed an ordinance ordering the necessary lighting posts and appliances to be installed and maintained and electric current to be furnished for the lighting of portions of Olympia boulevard, Laconia boulevard, Figueroa street, 121st street and 124th street.

NOGALES, ARIZ.—The street lighting committee has prepared a report which it will present to the city council at the next meeting. It is recommended that the city install ten 5-light clusters on lamp posts, with two circuits, said lights to be distributed along the business district at distances of about 120 ft. It is also recommended that 150 bracket lights be distributed in the residence district, not less than 200 ft. apart, these to be 100 watt globes. The estimated cost of the installation of this system is about $20,000.

TRANSMISSION

BELLINGHAM, WASH.—The school board is planning to install a power plant in the Whatcom High School.

SEATTLE, WASH.—G. W. Lawton will prepare plans for a power house to cost $35,000 at the Sedro-Wooliey Hospital.

KLAMATH FALLS, ORE.—The city council has granted the Keno Power Company the right to furnish the city of Klamath Falls with light and power for 25 years.

SACRAMENTO, CAL.—The Walker Mining Company is about to develop hydroelectric power on Ward Creek, five miles from Genesee, to be utilized at the Walker mine.

TOPPENISH, WASH.—Wapato's city council has granted a 50 year franchise to the Pacific Power & Light Company for the installation and operation of light and power lines.

SUISUN, CAL.—The board of supervisors has granted a franchise to the Vallejo Electric Light & Power Company, to construct and operate along certain highways in the county of Solano.

SOCORRO, N. M.—The local interests of B. W. Hill and associates have been taken under option by Charles E. Stewart of New York, who proposes to complete a hydroelectric installation.

LOS ANGELES, CAL.—The city attorney has been instructed to prepare an ordinance providing for ornamental lights on Camino Palmero, also on Franklin avenue, between Fuller avenue and Camino Palmero.

WASHINGTON, D. C.—Secretary Lane has refused the application of the Yosemite Power Company for a permit to use the Poopenaut reservoir and incidental works and rights of way within the Yosemite National Park.

SEATTLE, WASH.—Oliver T. Erickson, chairman of the committee on public utilities, has presented a report asking for $50,000 for repairs and enlargements of central substations, and $75,000 for distribution stations.

WATTS, CAL.—The board of trustees has ordered the improvement of Elm street from Shorb avenue to Ruoff street by the installation of ornamental electric light standards with necessary conduits, wires and other appurtenances.

SAN FRANCISCO, CAL.—The contract for furnishing and delivering electric line transformers for the lower Cherry River power development, Hetch Hetchy water supply, has been awarded to the Moloney Electric Company.

SEATTLE, WASH.—The Sound Paper Company recently incorporated at Olympia with a capital of $5,000,000 is planning the establishment of a paper mill on the Sultan River. A power plant would also be established as part of the project.

PHOENIX, ARIZ.—At a meeting of the board of governors of the Water Users' Association, a contract with the Magma Copper Company, whereby the copper people will build a power plant capable of generating 600 kilowatts, was approved.

LOS ANGELES, CAL.—Floyd Brown has filed application with the State Railroad Commission for authority to install and operate an electric light and power plant in Blythe. It is stated that he has already contracted for the purchase of a plant and equipment.

KINGMAN, ARIZ.—It is stated that the finances of the Chloride X Ray Mining Company which owns the Spargo property, are successfully provided for and that a power plant will soon be installed. This will consist of a 100 h.p. engine and five drill compressors.

PORTLAND, CAL.—The Puget Sound Traction, Light & Power Company has entered into a contract with the Olympia Light & Power Company, to construct a power line from Fern Hill, near Tacoma, to the boulevard road and supply 55,000 volts of high tension power.

ST. JOHNS, ARIZ.—The board of supervisors has granted a franchise to Gustav Becker for the construction of electric light and power lines over and across public roads and highways of the towns of Springerville and Eager and other towns and places in Round Valley, Apache County.

FRESNO, CAL.—Officials of the San Joaquin Light & Power Company have decided to erect a new substation at Chowchilla; one is being built at Madera and large extensions are being made in the farming sections. The station at Henrietta is to be either enlarged or duplicated.

SPOKANE, WASH.—Construction of a high tension power line from its plant at Long Lake, 25 miles down the Spokane River, to Northport, Wash., is under consideration by the Washington Water Power Company, according to D. L. Huntington, its president. The line will be, if it is built, about 90 miles long.

PASCO, WASH.—The Pacific Power & Light Company has presented a petition to the board of county commissioners for a franchise to construct and maintain high tension electric transmission lines through Franklin County from Pasco to connect with the transmission line of the Washington Water Power Company, at Lind.

BRAWLEY, CAL.—The Southern Sierras Power Company, which holds a blanket franchise for Palo Verde Valley from Riverside County, has started building a line to Blythe, Cal. A temporary plant will be maintained until lines are brought across the mountains from Niland. The work is being superintended by P. W. Greenleaf.

HALFWAY, ORE.—A power line will be constructed from Robinette to Cornucopia and work will begin in about a month. The city council has granted the Idaho Light & Power Company a franchise to furnish electricity to the residents of the town. It was also voted to let a ten year lighting contract to the same company at the rate of $380 a year.

LOS ANGELES, CAL.—The city council has adopted a resolution covering power-bond matters. The first of these approves the temporary power contract with the Southern California Edison Company and the Pacific Light & Power Corporation and the second approves the ten-year purchase contract subject to the vote of the people on issuance of $12,000,000 in bonds.

WICKENBURG, ARIZ.—At a special election here bonds in the sum of $17,000 were authorized, of which $5000 is to be applied to the extension and betterment of the present municipal water system and $12,000 to the installation of an electric light and power plant. As soon as legal formalities are gone through the specifications for the plant will be prepared, the contract let and work started.

LOVELOCK, NEV.—Construction of a quarter million dollar 73 mile power line as well as a power plant to be built along the Truckee River near Vista, were included in the plans of the Nevada Valley Power Company announced by Vice-President and General Manager John Q. Brown. The new power plant will be to develop additional power to that secured from the plant at the government's big dam at Lahotan.

PHOENIX, ARIZ.—Residents of the Higley district have begun a campaign for the securing of electrical power for pumping for their lands. They have formed what is known as Electrical District No. 2 of Maricopa County, for the purpose. Contributions are now being asked to help defray preliminary expenses and for getting things in shape for the sale of an issue of bonds, under the direction of the board of supervisors.

SALT LAKE, UTAH.—One new power plant is to be built, two plants which have been out of commission for more than three years, put in operation and many miles of new transmission line strung at once by the Southern Utah Power Company and the Beaver River Power Company, controlled by L. L. Nunn. A high tension line from Richmond to Fillmore is included in the plan. A number of small transmission lines are to be built to other sections of Sevier, Beaver and Piute counties to care for mining companies.

WINNEMUCCA, NEV.—The Nevada Valley Power Company has started the survey for a high power electric line from Winnemucca to Golconda, and thence down Adelaide Valley, where it will connect with the main power line that is being established from Rochester to Battle Mountain. The intention of the Company is to distribute light and power through this section of Nevada. The company will also extend its power line by as direct a route as possible to Battle Mountain from Rochester. From Winnemucca it is the intention of the company to make other extensions into adjacent territory.

REDDING, CAL.—The tunnel of the Mount Shasta Power Corporation in the Big Bend of the Pit has been driven a distance of one mile, according to W. A. Cooper, general manager. Small crews are working at both ends. The aggregate length is a little over a mile. The tunnel is 7 feet high and 9 feet wide. Ultimately the tunnel will be made 17 feet wide and 19 feet high. This company will have only one tunnel, about seven miles in length. The Northern California Company's tunnel in the same region is in 700 feet. This company will have five tunnels. The intakes of the two companies on the Pit are two miles apart, but the outlets of their water tunnels will be eight miles apart.

TRANSPORTATION

SAN FRANCISCO, CAL.—Bids are being received by the board of public works for furnishing and delivering wood ties on contract No. 90, municipal railway system.

PASADENA, CAL.—Horace Dobbins gave a summary of the plans of a proposed municipal railway at a meeting of the Men's Club of Lake Avenue Congregational Church. The total cost of the proposed road is estimated at $2,500,000.

GRENADA, CAL.—The principals of the movement at Grenada have made a survey for the new electric road from Grenada to the Moffit Creek divide, and are now surveying the route by way of the Forest house, to ascertain which will be most feasible.

LOS ANGELES, CAL.—The Pacific Electric Company has more than doubled its authorized expenditure for company's shops at Torrance. Immediate appropriation for shops and equipment of $1,100,000 has been authorized by directors and officers of the company.

RIALTO, CAL.—The board of trustees has granted a franchise to the Pacific Electric Company for the construction, maintenance and operation of a five standard gauge, single track spurs and one standard gauge single track siding over, along and across certain sreets in the city of Rialto.

EAGLE ROCK, CAL.—Application has been made to the board of trustees of the city of Eagle Rock for a franchise granting the right to construct and for a period of 50 years to maintain a single track, standard gauge railroad for the purpose of carrying freight and passengers, with authority to propel cars thereover by electricity or other motor power, across Colorado boulevard between Central avenue and Bowland avenue.

TELEPHONE AND TELEGRAPH

VICTORVILLE, CAL.—General Manager Hess of the Interstate Telegraph Company plans to extend the telephone line to Bear Valley resorts this summer. The line is expected to be extended from Victorville.

WICKENBURG, ARIZ.—The district manager and the district wire chief of the Mountain States Telephone Company, have been here after the inspection of the country from Wickenburg to Parker with a view to installing a telephone line between those points.

SACRAMENTO, CAL.—Articles incorporating the Delta Telephone & Telegraph Company, which proposes to build a five-mile telephone line in Sacramento County, have been filed with the county clerk. The directors are H. W. Glensor, Scott Hendricks, E. V. Kenney, A. D. Downing and H. J. Edwards, San Francisco, and A. J. Miller, Berkeley. The company is capitalized at $350,000.

ROY, N. M.—A telephone meeting held last week at Pleasant View resulted in two rural telephone lines being planned and promoters are busy getting details of the plan completed and ready to do the work immediately. One line will run out by way of Liberty and Pleasant View to J. W. Johnson's and the other south and east of it. Twelve to fifteen phones will be on each line and will be connected with the Roy switchboard.

MESA, ARIZ.—A resolution has been adopted by the common council calling a special election to be held on May 15th, at which election bonds in the sum of $125,000 will be voted upon, for the purpose of acquiring funds for supplying the town with an artificial lighting system to be owned and controlled by the town. The issue is to consist of 250 bonds, numbered from 1 to 250, inclusive, in denominations of $500 each, dated July 15, 1917, and bearing interest at rate of 2½ per cent per annum, payable semi-annually.

IRRIGATION

VISALIA, CAL.—Engineers will begin shortly collecting data in connection with the proposed dam on Horse Creek, with which to impound the flood waters of the Kaweah River section, and of which the estimated cost has been placed at $8,000,000. Irrigation of more than 500,000 acres of land will be possible.

YREKA, CAL.—The organizers of the irrigation district for Scott Valley, have presented a petition to the board of supervisors asking that an election be called to have an irrigation district formed to comprise 40,000 acres. They plan to take the water from Scott River, which flows through the land, and carry it in a ditch that will be 20 miles in length when completed.

VICTORVILLE, CAL.—By unanimous vote the Mojave River irrigation district, embracing 27,000 acres in Apple and Victor valleys, has been formed. Directors—A. E. Hull, A. M. Byrom, Walter Paino and O. L. Morgan will at once organize and prepare the engineers plans for the development of water on the San Bernardino mountains and for a distributing system to cost about $2,000,000. A bond issue will then be submitted to voters.

ANDERSON, CAL.—Twelve carloads of mules and equipment has arrived here, being consigned to the Shattuck, Edington Company of Los Angeles. This company recently took the contract to complete the major part of the excavation work on the Anderson-Cottonwood irrigation district. Work will be begun just as soon as a camp is established and men are secured, for it is the purpose to rush the excavation so as much land as possible may be covered with water this season.

SAN FRANCISCO, CAL.—The Byron Irrigation Company of Byron, Contra Costa County, has filed with the railroad commission an application for a certificate that public convenience and necessity require it to construct and operate its system in Contra Costa, Alameda and San Joaquin counties. The reason for desiring the irrigation is that the land has become too valuable to cultivate to the ordinary annual crops, dependent wholly upon rainfall, and the rainfall has not been sufficient for several years.

KLAMATH FALLS, ORE.—The question of the organization of the Klamath irrigation project, as an irrigation district, is again receiving attenton here. The irrigation law has been enacted in law by the state legislature. As a result, several members of the board of directors of the Klamath Water Users' Association now declare for the organization of an irrigation district. It is declared that should an irrigation district be formed, local ranchers would be permitted to apply for loans under the Federal Farm Loan Act.

PORTLAND, ORE.—J. L. Stannard, consulting engineer employed by the council to report on the cost of the proposed municipal light plant, has completed his investigation and says that the project is not feasible. The reason given was that Ben Morrow, engineer for the Water Bureau, who supervised the preparation of estimates, based his cost on labor and materials on normal prices but as all materials, especially those which would enter into the construction of such a project have increased many fold, the funds asked to build the project are insufficient.

SAN BERNARDINO, CAL.—The landholders in Victor Valley have voted to form an irrigation district embracing 30,000 acres of land north of San Bernardino mountains for a reclamation project costing fully $2,000,000. The directors of the district are A. E. Hull, Walter Paine and A. M. Byron. A bond issue for $2,000,000 will be prepared immediately and the scheme will go ahead as rapidly as possible. The directors will frame up provisions for impounding the waters of the Mojave River in the east fork and submit these at the bond election within a few months.

BANNING, CAL.—W. E. Parker of Los Angeles and H. H. Merrell of South Pasadena have applied to the State Water Commissioners for permission to appropriate waters of several streams and other sources for the proposed carrying out of an extensive irrigation project. The applicants now make application to use the same waters for power purposes. Waters of Baldwin Lake, Antelope Pipes, Little Morongo, Big Morongo, Mission Snow, Tahquitz creeks and Whitewater River are specified in the application. They have also applied for permission to appropriate all of the unappropriated waters of Tahquitz Creek, Andreas Canyon Creek and West Fork of Pal Canyon Creek.

In This Issue *A Noteworthy Symposium on Electric Rates, and Electric Cooking and Water Heating, by a Number of Prominent Men of the Electrical Industry throughout the West*

JOURNAL OF ELECTRICITY

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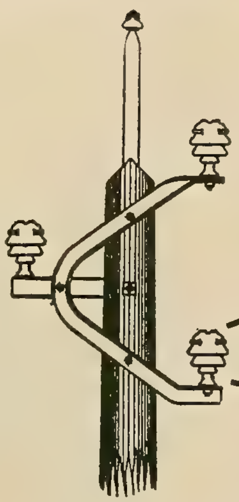

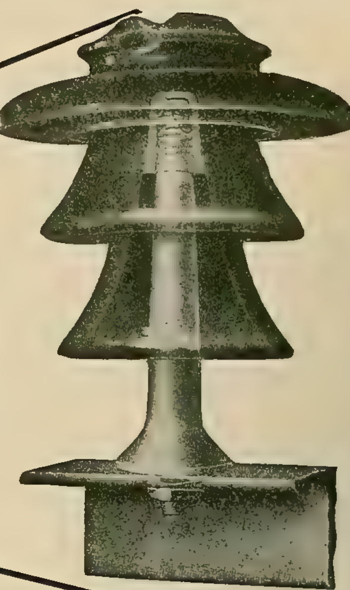

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The Multiple Arch from the Rear, showing its Non-Leakable Nature When Under Water Pressure

ROCK CREEK MULTIPLE ARCH DAM

BY R. A. MONROE

(Multiple arch dams under certain definite conditions are finding broad application throughout the West. Here is a new advance in such design in that knuckle joints are made at the juncture of each arch with its support. This provision makes possible a certain elasticity and freedom from strain not otherwise experienced in multiple arch installation. This article as a consequence should receive wide attention from engineers throughout the West. The design in question is that of the new Rock Creek Dam for the Wise power plant of the Pacific Gas & Electric Company. The author is the engineer who had charge of the detail design under the general direction of the civil and hydraulic engineer of the company.—The Editor.)

A Multiple Arch Unit Under Construction

THE Pacific Gas & Electric Company has recently completed the James H. Wise hydroelectric development in Placer County, California. The installation at the Wise Power House consists of a 20,000 h.p. turbine, and uses the water from Spaulding dam after it has passed through the Halsey and Drum power houses which are located higher up in the mountains.

One of the most interesting features in connection with this development is the Rock Creek Multiple Arch Dam, which is located about four miles north of Auburn. It is built across the channel of Rock Creek and creates a reservoir which serves to regulate the flow in the canal between the Halsey and Wise power houses, and also to provide additional storage to take care of the peak load requirements of the Wise Power House.

The dam as at present constructed consists of two sections. The main channel is spanned by a multiple arch concrete dam of 1050 ft. in length, which at one end is joined to an earth fill dam of 825 ft., the crest length making an angle of 30° with the center line of the multiple arch dam. It impounds a net storage of 440 acre ft., and is designed to permit of raising 17 ft. in height which will increase the reservoir capacity to 2500 acre feet. When this extension is made, it is intended to replace the earth wing dam with a multiple arch concrete dam.

The earth dam contains 11,690 cu. yds. of material and has a maximum height of 15 ft. The crest width is 10 ft. with a slope of 2½ to 1 on the upstream face and 2 to 1 on the downstream face. The outlet structure for the canal is located in this dam and the flow is controlled by two 4 ft. by 6 ft. motor operated gates.

The multiple arch dam consists of 35 arches of 30 ft. span each, giving a crest length of 1050 ft. The maximum height of arch when the dam is completed will be 53 ft. above the foundation level, but at present the maximum height is 17 ft. less than this.

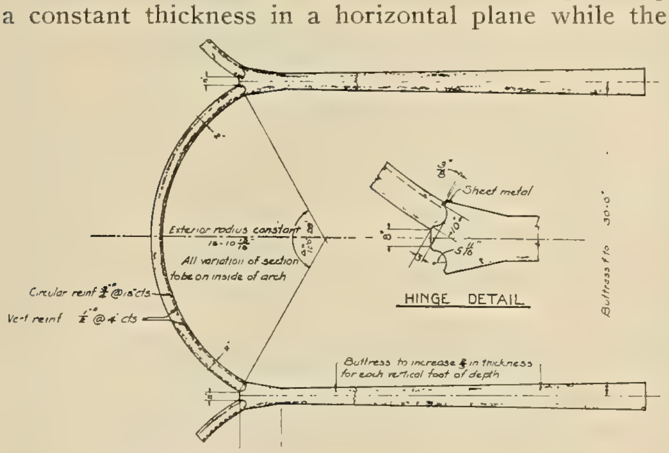
Front View of Rock Creek Dam

The buttresses are 4 ft. long by 12 inches thick in plan on top and increase in thickness two inches for each five feet in depth. On the downstream face the buttresses have a batter of one in twenty and in the plane of this face at 17 ft. intervals horizontal reinforced concrete beams are used to brace them.

The arch rings are circular in the plane of the water thrust and the axis is inclined at an angle of 45°. The radius of the extrados or upstream face is constant, being 16 ft. 10 13/16 in. All variation of section are on the intrados, and between hinges the arch ring subtends an angle of 120° 28′. The thickness of the arch ring normal to the water thrust at the crest is 12 in. and increases one inch for each ten feet of vertical depth.

In the design of the arch ring the following factors were taken into account in the stress calculations, which were made for a section of ring normal to the inclined axis: Temperature range, dam full 35°; temperature range, dam empty 45°; coefficient of shrinkage of concrete .0003; and rib shortening due to dead and live load.

The variable dead load due to the arch ring having a constant thickness in a horizontal plane while the



The Hinge Detail for the Multiple Arch

section considered is taken in a plane inclined at 45°.

In order to check the assumed temperature range, thermometers have been installed in the concrete of the dam and the results so far are such as to justify the assumptions made in the design.

In order to reduce the excessive bending stresses which are caused by the above loadings in a hingeless arch, the structure is designed as two hinged. The hinges are formed of concrete, and located at the point where the arch ring joins the buttress as shown in the accompanying plan. As the radius of the ball and socket joint was kept small in order to avoid excess frictional resistance to turning, the curve of the hinge did not reach through the arch rib. In order therefore to allow for movement of the joint, it was necessary to fasten a U-shaped strip of sheet metal to the downstream face of the buttress hinge. This served to keep the concrete of the arch from butting up against the buttress, thus permitting the hinge to rotate. Rotation in one direction only was to be expected so this provision was only made for one face. In constructing the dam, the buttress hinge face was carefully smoothed down and painted with graphite paint before the arch ring was poured up against it.

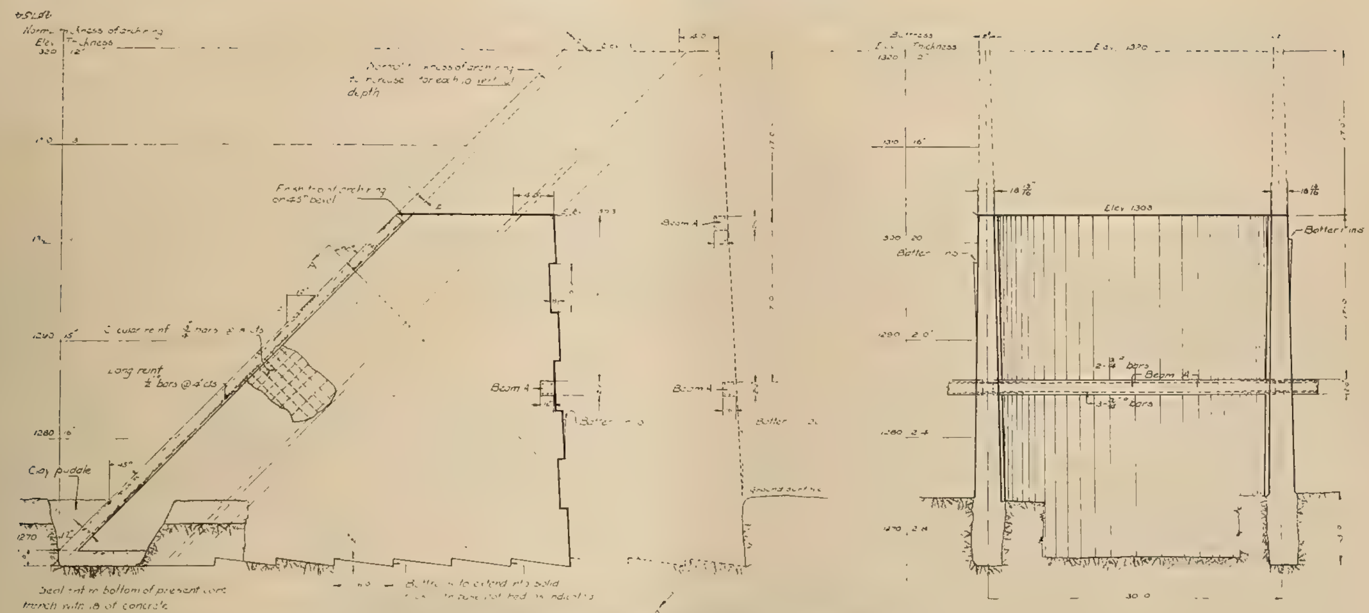
The buttresses are not reinforced nor is the extrados of the arch. The intrados of the arch is reinforced longitudinally by ½ inch square bars at 4 ft. centers and in the plane of the circular ring by ¾ inch square bars at 18 inch centers.

A spillway is provided near the center of the dam to care for a maximum flow of 925 sec. ft. The spillway crest is dropped 3 ft. below the crest of the main dam for a width of two of the arches and a slab is carried down the back of the buttresses supported by beams extending between them.

The foundations are in general carried down to solid rock which varies from 1 ft. to 8 ft. in depth below the ground surface. In two cases after going down over twenty feet no solid rock was encountered, so the footing for these buttresses is spread to ten feet in width and designed as a slab.

For the construction work the concrete plant was located at one end of the dam and a trestle was built the full length of the dam to an elevation of 8 ft. above the crest. This trestle was 8 ft. wide and a track was laid over which steel side dump ore cars of 20 cu. ft. capacity were pushed by hand to convey the concrete. From the top of the trestle the concrete was spouted into place. The buttresses for the entire dam were poured first, each buttress being completed in one pour. The arches were poured in three sections of about twelve arches each; the concrete being deposited along the entire length of the section. Two shifts of eight hours each were employed in pouring the arches.

Forms for the buttresses were built up in place, except those for the hinge joint which were sectional. The forms for the intrados of the arch were built up, using two layers of ½ inch thick O. P. sheathing bent horizontally over studs spaced at two foot centers which were held in place by built up circular rings two inches thick, inclined at 45°, and spaced at 8 ft. centers. The forms for the extrados of the arches were



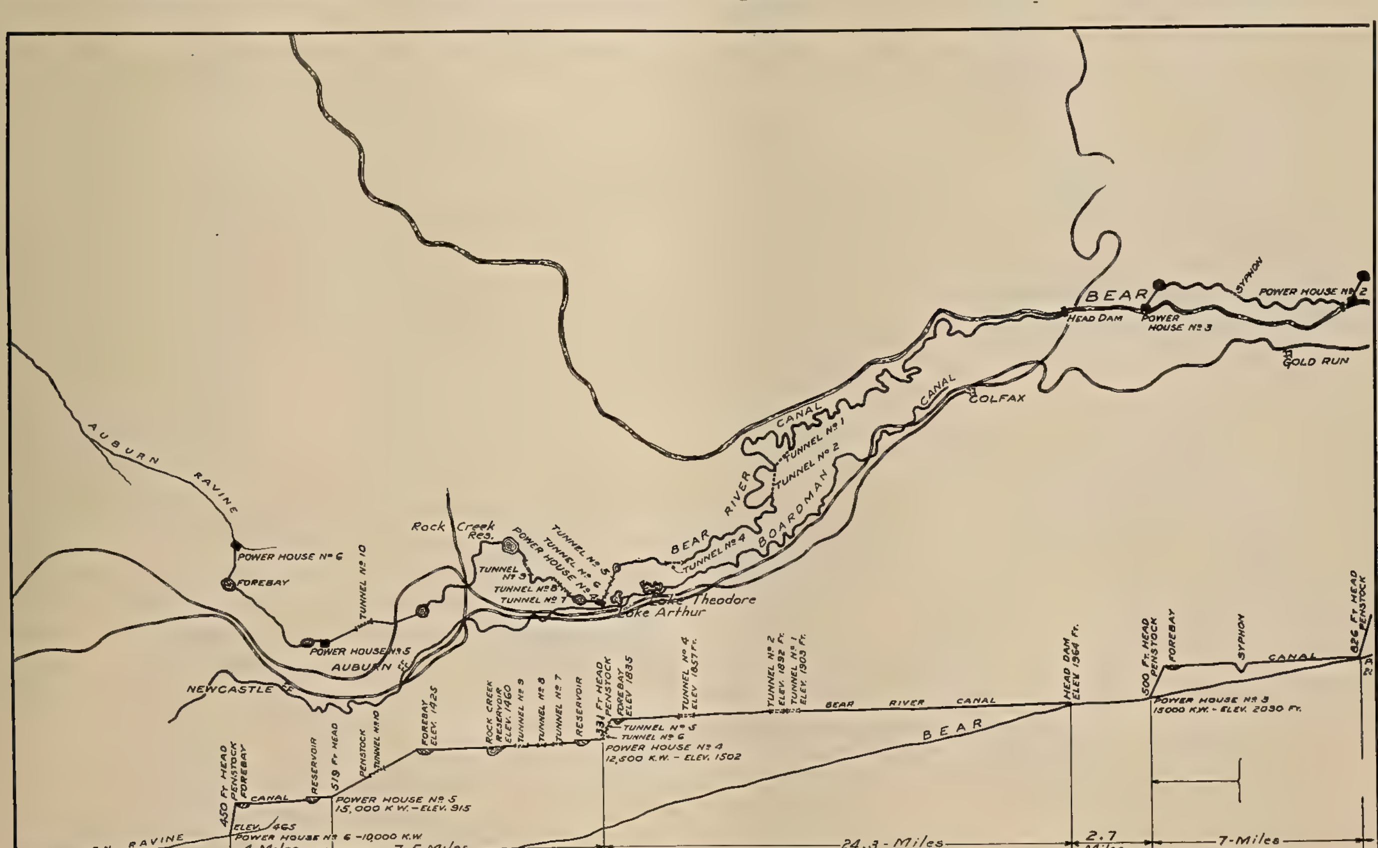
Side and Rear Elevation of Buttress

sectional, each section being 3 ft. wide by 6 ft. long. It was found that four rows or layers of the exterior sectional arch forms were necessary for the length of the section being poured in order to allow the work of pouring and stripping to proceed simultaneously.

The concrete mix for the buttresses was 1-2-½-5, and that for the arch rings was one part cement, one an one-half parts sand, two and one-sixth parts rock of size dust to ¾ in. and 2 1/6 parts rock of size ¾ in. to 2½ in. The latter mix was decided upon for the arch ring after an elaborate series of tests in the field laboratory located on the site.

The dam has been tried out by the impounding of water in the reservoir as shown in the illustration and has proved non-leakable in every detail. Such water as did come through was easily traced to small fissures below the foundation setting and as a consequence the leaks were soon properly disposed of.

The dam was designed by the writer under the direction of H. C. Vensano, civil and hydraulic engineer of the Pacific Gas & Electric Company. The construction work was handled by J. H. Martin, superintendent of construction, and E. M. Whipple, division engineer. P. M. Downing had active charge of all the work on the Spaulding Development and served as chief engineer with F. G. Baum as consulting engineer.



A Portion of the Spaulding Development, showing Rock Creek Dam in its Relationship to the Wise Power House which is Power House No. 5

THE MANUFACTURE OF OXOGEN AND HYDROGEN

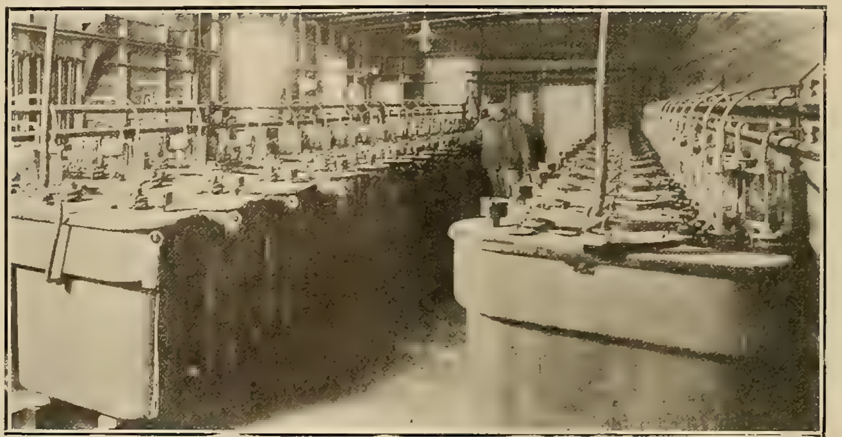
BY F. D. WEBER

(New industrial processes for the utilization of the vast hydroelectric energies of the West are constantly disposing of central station loads in ever-increasing quantities. Here is a description of an oxygen-hydrogen manufacturing plant at Portland, Oregon, which is not only developing in itself a most desirable central station load, but by the appearance of oxygen and hydrogen in Western markets at reasonable selling prices, it is thereby creating by-product industries in the utilization of oxygen and hydrogen in new and hitherto unattempted recoveries in this section of the country and as a consequence offers a possibility of accelerating central station sales in a geometric ratio.—The Editor.)

During December, 1915, a new industry was started in Portland, Oregon. It was the electrolytic manufacture of oxygen and hydrogen. This was one of the first of its kind installed on the Pacific Coast.

From the central station standpoint it is excellent business as the load is constant, 24 hours a day, and for 365 days a year.

To electrolytically manufacture oxygen and hydrogen, water is heated in the boiler and the steam is allowed to pass through coils in the base of the gas holders, which are sealed with water. This causes condensation of the steam, which is led into a small iron tank in the cell room. The cells are filled with this distilled water, together with 85 pounds of caustic soda per cell. The caustic soda lasts indefinitely and replacement is not necessary.



Fifty Cells for the Electrolytic Manufacture of Oxygen and Hydrogen

This new industry at Portland, wherein oxygen and hydrogen are manufactured by electrolysis, illustrates the many new applications of central station load throughout the various sections of the West. Such industries are not only valuable in themselves, but the constantly increasing activities set in motion by the appearance of their products in the market offer even brighter prospects for future hydroelectric development in the West.

The cells are connected in series electrically and it takes 400 amperes at 112 volts to operate 50 of them When the current is applied, the oxygen and the hydrogen immediately begin to be generated and are brought out of the cells through a water seal into different pipes. These pipes connect to all the cells and lead into the gas holders, twice as much hydrogen being generated as oxygen. When the water level in the cells is down, more distilled water is added in order to keep the water level up to the proper height.

The capacity of this plant is 4400 cu. ft. of oxygen in 24 hours and 8800 cu. ft. of hydrogen during the same period. Twice as much compressor capacity is installed for the oxygen as the hydrogen. Due to the explosive nature of oxygen the compressor lubrication is composed of castile soap and boiled water, as the oil would make an explosive mixture with the oxygen.

Compressors are used to charge the cylinders in which the gas is sold, there being two sizes used, one containing 100 and the other 200 cu. ft. respectively at a pressure of 1800 lb. at 70° F. The use of compressors plays an important part in an industry of this nature and the high pressure under which they operate necessitates careful attention in maintenance and operation.

The Portland Fire Department use small cylinders for fire fighting helmets, which are also charged at 1800 lb. The oxygen generated by this process is 99.7 per cent pure, which is the purest obtainable.

The hydrogen generated is used for various metal cutting processes when combined with oxygen. Recently a new process has been developed commercially for combining hydrogen with vegtable and animal oils in order to purify and refine these oils. This opens an immense field in the Northwest, especially when the salmon cannery waste can be utilized. Hydrogen until of recent years has been a by-product without any market, but now is salable as readily as the oxygen.

The hydrogen flame for cutting steel is more satisfactory than the oxyo-acetylene as it does not carbonize the plates. It will also cut thicker plates.

When the plant was first created only one-half of the cells were installed and half of the generator capacity was used. At present all 50 of the cells are used 24 hours a day and every day of the year. About April, 1917, the plant will be again doubled in size, making a total installation of one hundred cells.

The buildings in this plant consist of a one and two story frame structures; one containing all the equipment except the boiler. The main building has a concrete floor for the generating cells and the other machinery to rest upon. This building also contains a small office, charging racks for tanks, and warehouse, steam heat being used throughout. In the electrical equipment is to be found one Westinghouse motor gas set, consisting of one 75 h.p., 440 volt, 3-phase, 60 cycle, 1150 r.p.m. induction motor, direct connected to a 50 kw. 55-110 volt, 455 amperes, 1150 r.p.m., d.c. generator.

A Westinghouse standard slate motor generator central switchboard panel is equipped with over and under load trip coils and reverse current relays to

protect the generator from reversal of current in the cells.

Two 15 h.p. Westinghouse 110 volt d.c. motors are belted to shafting to operate air compressors. There are fifty International Oxygen Company's oxygen-hydrogen cells, Type 200 D.

The mechanical equipment consists of three Platt Iron Works air compressors, size 4½ by 3½ by 1 5/16 by 6, one 10 h. p. upright steam boiler; one 200 gallon water tank; one 5000 cu. ft. oxygen holder, and one 500 cu. ft. hydrogen holder

THE INTERNATIONAL METRIC SYSTEM

In order to forward the wide publicity campaign for an early adoption of the metric system, the following compilation of equivalents by the National Electric Light Association should be useful:

Table I.—International Units

(1) Amperes	(15) Years
(2) Volts	(16) Months
(3) Ohms	(17) Weeks
(4) Voltamperes and kilovoltamperes	(18) Days
(5) Watts, kilowatts and myriawatts	(19) Hours
(6) Kilowatthours	(20) Minutes
(7) Candlepower	(21) Seconds
(8) Watts per candle	(22) Dollars, cents and mills
(9) Lumens	(23) Dollars per year, month, week, day, etc.
(10) Lumens per watt	(24) Dollars, cents and mills per kw. hr.
(11) Revolutions per minute	(25) kw.-hrs. per year, month or day.
(12) Degrees (of arc)	(26) Kilograms
(13) Degrees centigrade	(27) Centimeters
(14) Cycles per second	

Table II.—Non-International Units and Their International Equivalents

Unit	Equivalent
(1) Acres	sq. m. or hectars
(2) Acre-feet	cub. m.
(3) Amperes per sq. in.	amp. per sq. mm.
(4) Amperes per 1000 cir. mils.	amp. per sq. mm.
*(5) Barrels (of oil)	Liters or hectoliters
*(6) Barrels (of apples) per year.	Liters or hectoliters per year
*(7) Boiler horsepower	kw
(8) British thermal units	watthours or kw.-hrs.
(9) British thermal units per hr.	watts or kw.
(10) British thermal units per lb.	watthours per kg. or kw.-hrs. per kg.
(11) British thermal units kw.-hr.	numeric
*(12) B. and S. gage of wire	mm.
*(13) Bushels (corn)	liters
*(14) Bushels (oats) per year	liters per year
(15) Cubic feet	cub. m.
(16) Cubic feet per sec. per hr. and per day	cub. m. per sec, per hr., per day
(17) Degrees Fahrenheit	deg. Cent.
(18) Degrees F. per hour	deg. Cent. per hr.
(19) Dollars or cents per acre	dollars or cents per sq. m. or hectar
*(20) Dollars or cents per bbl.	dollars or cents per liter
*(21) Dollars or cents per ton	dollars or cents per kg. or per metric ton
(22) Dollars or cents per 1000 lbs.	dollars or cents per kg. or per metric ton
(23) Dollars or cents per front ft.	dollars or cents per front m.
(24) Dollars or cents per lb.	dollars or cents per kg.
(25) Feet	m.
(26) Feet per sec.	m. per sec.
(27) Foot-candles	m. candles or milliphot
*(28) Gallons	l'ters or cu. m.
*(29) Gallons per day	liters or cub. m. per day
(30) Inches	cm.
(31) Miles	km.
(32) Miles per hr. or minute	km. per hr. or per min.
(33) Pounds	kg.
(34) Pounds per hour, day or year	kg. per hr., day or year
*(35) Pounds per gallon	kg. per liter
(36) Pounds per square inch or sq. ft.	kg. per sq. cm. or per sq. m.
(37) Pounds per kilowatt hr.	kg per kw.-hr.
(38) Square in., square ft. square yds., square miles	sq. cm.; sq. m.; or sq. km.
*(39) Tons	kg. or metric tons
*(40) Tons per acre	kg. or metric tons per sq. m. or hector

It has been assumed in preparing the above Table that whenever two units which differ in name are in simple decimal ratio, they are virtually one and the same. Thus dollars and cents are virtually the same unit of currency because a sum of money expressed in one is numerically the same as that expressed in the other after a shift of the decimal point. On the other hand, pounds, shillings and pence are different units.

SUGGESTIONS FOR OFF-PEAK HOURS—II

When next your friends call or you call upon them and you want to enliven the off-peak hours with shouts of laughter and dispell that grouch which has been hovering over your face for some time past, try the following little prescription:

Buy a thirty-cent box of marshmallows and about twelve feet of clean white cotton string. Tie a marshmallow to the center of the string and ask two lady guests to place the ends of the string in their mouth and at a given signal start to eat the string until the marshmallow is reached, the one arriving at this goal first to have the box of marshmallows as a prize. Shades of fallen dignity and short-circuiting of high powered transmission lines! The shrieks of laughter and side-splitting fun that will result will store up in your system a smile and a happy, pleasant feeling that will carry you over many a period of heavy care in peak load hours of the day.

A NEW ELECTRICAL FURNACE AT SALT LAKE CITY

The American Foundry & Machine Company of Salt Lake City have installed an electrical furnace for producing steel castings. This new installation was designed by Iowan Renerfelt, a Swedish engineer. The furnace occupies a space seven feet by nine feet by nine feet high and weighs about seventeen tons. It has a capacity of three tons, producing eighteen tons of steel per day.

The electrical furnace is lined with magnesite brick, with chrome brick bottom, with closely fitting charging and casting doors at opposite ends of the chamber. The electricity is admitted by the electrodes one from above, and through the opposite sides of the furnace, adjustable by hand. This enables the operator to run it independent of the size of the charge, or with arcs in contact with the metal if so desired. The electrodes inserted through the sides, on being adjusted, touch each other, and as they are drawn apart, the electric flame leaps from one to the other, increasing in intensity and temperature as the distance increases while a vertical flame from the upper electrode, forces the horizonal flame down on the charge, forming an arc. This form of arc has hitherto been unknown to electric furnaces, and is one of the reasons for success of the Renerfelt type. This furnace is practically a large internally heated crucible, charged with cold metal.

The superiority of this process over the open hearth or Bessemer converter process is claimed to be a much higher grade of steel, a valuable factor in this being that the heat can be absolutely controlled which, it is stated cannot be done in an open hearth furnace. Further, there is no oxidation which results in a freedom from the presence of objectionable gases, technically known as "occluded" gases. It is said there are but six units of gas in the electically operated furnace steel, to 50 and 60 units in the steel manufactured by the older processes. The slag introduced to draw out impurities, is artificial, two applications being generally necessary, resulting in a greatly improved product. The American Foundry & Machine people are delighted with the results of this furnace.

RECENT RULINGS ON UTILIZATION SAFETY ORDERS

(Electrical utilization safety orders have been the talk of the hour during the past six weeks not only in California, but in other sections of the West. Here is a series of questions and answers of timely import that should be read by all electrical contractors and others throughout the West who are in any way handling the problems of utilization of electrical energy. These notes have been arranged by the California Section of the Electrical Inspectors' Association co-operating with the Industrial Accident Commission of California through its electrical engineer, Robert L. Eltringham.—The Editor.)

Queston 1: Are externally operated switches necessary for control of temporary motors on building construction? (From one to six months' service).

Answer: When externally controlled switches would be required for the same installation, if permanent, they must be installed on temporary work unless it conforms to the requirements of S. O[1], 730, which requires competent supervision or protection by suitable barriers or warning signs when alive and accessible.

Question 2: Are externally controlled service switches required on electric sign or lighting installation on bill boards?

Answer: No. When the entire equipment of switches, cutouts, etc., is enclosed in a weatherproof locked metal cabinet, not accessible without unlocking, an externally controlled service switch may be omitted provided a wooden platform insulated from the ground is arranged so that access to said cabinet is had only when standing upon the platform.

Question 3: On what motor installations are no-voltage release devices required?

Answer: On all installations where, in the opinion of the Industrial Accident Commission, the physical hazards are not sufficiently well guarded to render the no-voltage release unnecessary.

Application for exemption from the use of no-voltage release should be made directly to the Industrial Accident Commission.

Question 4: Will double pole snap switches be approved on motors up to 30 amperes? If not to 30 amperes, to what capacity?

Answer: It is assumed that the question refers to the switch located at the motor or control devices.

Double pole snap switches on motors are permitted.

(1) When used only to disconnect cutouts for purpose of re-fusing;

(2) When used on motors whose starting current does not require the use of auto-starters or compensators;

(3) When used to disconnect leads to auto-starters or compensators whose construction requires a switch ahead of the device.

Snap switches are approved for 30 ampere, 250 volt triple pole capacity.

There is no restriction of size for motor use within the capacity of the switch used.

Question 5: How may exit and hall lights be connected ahead of service switch and on a single meter with balance of building load?

Answer: Installation shall be made as follows:

Main service switch (located where wires enter the building) and cutout shall be inclosed in approved cabinet with door kept securely locked. Thence through meter and branching to two switches and cutouts. First, a service switch and cutout located as required for accessibility, inclosed when so required by the Safety Orders, and controlling entire house load except exit and hall lights. Second, a similar switch and cutout controlling exit and hall lights and inclosed in an approved metal cabinet with cover fastened on with bolts or machine screws.

Main service switch and cutout shall have the capacity of and be fused to 125 per cent of the combined capacities of the service cutout and exit light cutout. Service switch and exit circuit switch to correspond with respective fuse capacities.

In an installation made as above, the "service" switch shall be used for all purposes required of a "main" service switch on the usual installation.

Cabinets required above shall have a legible warning against removing fuses before switch controlling same is opened, which shall be placed on the outside of the cover.

Question 6: Is it the purpose of the Safety Orders to require externally controlled switches on all utilization equipment?

Answer: (a) No. The orders require the use of externally controlled switches only when used on circuits of over 150 volts to ground or when installed in damp places or where local conditions entail a particular hazard.

(b) Switches installed to allow disconnection of cutouts for re-fusing, whether located at distributing centers or adjacent to control devices, need not be externally controlled unless within the restrictions of paragraph "a" above.

(c) Switches used in lieu of auto-starters, compensators, etc., for control or operating purposes, shall be externally controlled if within the restrictions of paragraph "a" above.

(d) Auto-starters, compensators, etc., are accepted as externally controlled devices. No switch is required ahead of them when they are so arranged as to entirely disconnect the current from all fuses when in the "off" position. When not so arranged, a switch is required immediately ahead of device to disconnect fuses while re-fusing. (See paragraph "b" above.)

(e) Fuses are not required on auto-starters, compensators, etc., if equipped with a satisfactory overload release device.

Question 7: Is an externally-controlled service switch required on all installations except flats and dwellings?

Answer: Yes. Order 737 (a) as revised requires a switch, regardless or voltage, ahead of cutout "in basements where concrete floors exist, or where dampness is prevalent at any or all times, or where the operator may have to stand on grounded surfaces in order to re-fuse the cutout."

Order 740 (a) requires an externally-controlled switch in all damp or hazardous locations.

The department holds that, as service switches are placed in practically all installations in the basement, tradesmen's entrance, or some other damp or dark situation that a general rule requiring externally-controlled switches is fair to all concerned.

In flats or dwellings, externally-controlled switches are not required.

Question 8: In what installations are locking devices required on switches controlling utilization equipment?

Answer: (S. O. 736 e). In all installations where it is possible to come in physical contact with moving parts of the motor or devices connected thereto. Where such moving parts are properly guarded, locking is unnecessary. (The adequacy of such guards can be passed upon only by the inspector of the Industrial Accident Commission, when guards are submitted in lieu of locking the switch.)

The device shall be a substantial mechanical contrivance with lock and key so arranged that the switch cannot be operated when locked open except by use of the proper key.

Question 9: What constitutes an "approved" electrical appliance for use in San Francisco?

[1]The abbreviation S. O. is used to designate "Safety Orders" referring to the Electrical Utilization Safety Orders of the California Industrial Accident Commission.

Answer: Ordinance 2582 requires that "........, electrical wires, fixtures, appliances, apparatus or construction .... conform with the best known general standard existing at the time ...."

The National Electrical Code is the standard thus specified. Compliance with the Code and approval by the Underwriters' Laboratories are necessary under the standard.

The Safety Orders respecting electrical work issued by the Industrial Accident Commission are effective in San Francisco and superior to any conflicting local requirement. The commission approves devices only for "function" with respect to the Safety Orders, and does not examine such devices for electrical or mechanical requirements.

The department therefore requires, first—the approval of the laboratories on all devices to comply with the Code; second, the approval of the Industrial Accident Commission as to function on all devices installed within the requirements of the Safety Orders.

Pending submission to the laboratories locally made devices may be installed if temporary approval is given by the local representative of the laboratories, which approval is accepted by the department. (This representative is the Chief Inspector of the Board of Fire Underwriters of the Pacific.)

Question 10: What grounding is required to comply with Order 703 in inside work?

Answer: Service entrance conduit shall be grounded inside the building with separate ground wire not connected to neutral ground. Shall be No. 6 B. & S. gage copper where wires in conduit are not larger than No. 0 and need not be greater than No. 4 for larger wires.

The neutral wire of all 3-wire secondaries, except 3-phase and d.c. shall be grounded ahead of the service switch and inside the building with an insulated copper wire of size indicated by main service cutouts. Ths ground shall always be run as a separate conductor from neutral to ground. (D.C. neutrals shall not be grounded within a building.)

Neutral ground wire shall always be installed as required for a current-carrying conductor. Unless run in approved conduit, it shall be protected by porcelain bushings through walls and partitions and installed as required for knob and tube work. When run in conduit, the conduit shall be grounded, preferably by bonding to the service conduit, or the service conduit ground wire.

All utilization equipment shall be grounded when connected to circuits of over 150 volts to ground. This requires all d.c. motors to be grounded, for the reason that d.c. power service is obtainable in San Francisco at over 150 volts to ground.

All metal conduit, metal moulding and metal armored cable and cord shall be grounded with copper wire of size indicated by cutouts protecting the wires contained therein. to ground, and less than 300 volts potential requires a separate ground, on the frame or case of the utilization equipment.

More than one ground wire may be run in the same conduit or one wire of sufficient size to equal the total carrying capacities of the connected ground wires may be used as a bus ground conductor, if grounded at more than one place. The neutral ground and the service conduit ground shall not be run in the same conduit with grounds for building installation or utilization equipment. The neutral ground and service conduit ground may be run in the same conduit, the neutral ground being an insulated wire.

Bare wire (except for neutral ground) may be used. Ground wires must be run in a substantial manner but need not be run as required for a circuit wire. Protection where required, such as boxing-pipe, guards, etc., must be installed. Wires must also be located when possible that theft is difficult.

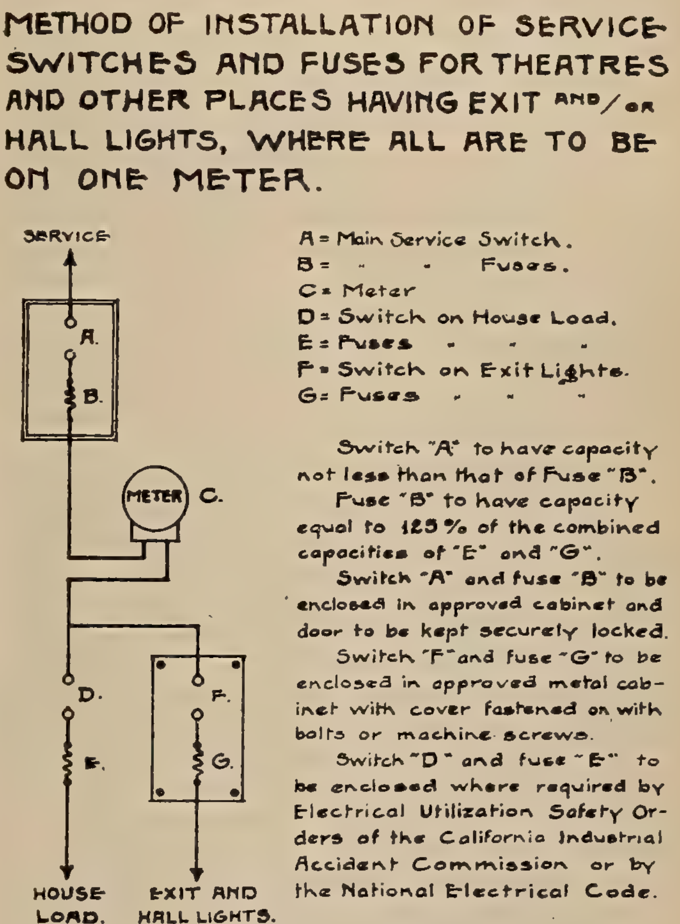
Ground wires (except service entrance conduit) shall be

No. 10 for cutouts of	0 to	50 amps. capacity.
No. 8 for cutouts of	51 to	100 amps. capacity.
No. 6 for cutouts of	101 to	200 amps. capacity.
No. 4 for cutouts of	201 to	500 amps. capacity.
No. 2 for cutouts of	501 to	1000 amps. capacity.

UNDERWRITERS NOTES FOR SERVICE INSTALLATION IN THEATRES

BY C. W. MITCHELL

On account of the increased cost to the consumer due to the State Railroad Commission's ruling regarding rates where two meters are installed, as in theatres, for example, it has been deemed desirable to arrange a method whereby the entire load could be measured by one meter.



Graphic Instructions for Service Installation in Theatres

The illustration shows such a method and is correct except that the paragraph describing the enclosure for main service switch and fuses should read as follows:

"Switch 'A' and fuse 'B' to be enclosed in approved cabinet and door to be kept securely locked or sealed."

For the purpose of sealing this cabinet a metal seal such as the "Metropolitan" will be accepted.

Large Utility Earnings.—Reports of 325 public utility corporations to the Financial World show for 1916 a total gross revenue of $1,223,006,181, an increase of $227,945,649, or 29.25 per cent over 1915. Net earnings were $550,920,933, a gain of $158,171,953, or 20.24 per cent over 1915. The companies have $2,864,325,700 outstanding bonds, $963,377,500 preferred stock and $2,506,637,835 common stock.

WOMEN IN THE ENGINEERING INDUSTRIES

("Women in the engineering industries" is a subject that is receiving far too little attention in the present national crisis. Below is an account of some of the marvelous things that British women are accomplishing to assist their government through the present troublous times. Serious thought should be given to this problem in these days of preparation. A little training and emergency education at this period, under skillful advice while service may be still made as helpers, will aid much when the test comes later.—The Editor.)

Our British cousins are some two or three years ahead of American citizens in solving the problems of industry and engineering activity brought on by the great European conflict. The Electrical Review of London has recently discussed the question of women in the engineering industries which is abstracted below that doubtless will prove interesting to engineers throughout the West:

The manner in which women have come to the assistance of the empire in taking the places of men of fighting age and fitness and in facilitating the most necessary work, must fill us all with admiration, but it is of the greatest possible importance that the movement, with its magnificent record should not stop where it is. There is need for the employment of female labor to be carried much farther than it has yet gone for the number of fighting men must be increased continuously until the enemy has been utterly defeated, yet the output of munitions for our men must be maintained at all costs. Of course, it is no new thing for women to be engaged in lamp-making, armature winding, accessories manufacture, and so one, but at a recent exhibition in England, there was brought together a collection of articles of many other kinds upon which women have brought their now proved adaptability and deft fingers to bear. Sparking plugs complete magnetos, lamp-holders, armature parts, lighting switchboards for mechanical transport work ad scientific instruments, are among the purely electrical examples upon which women have worked either at drilling or milling, winding, engraving assembling and so forth. But the collection of photographs carries us into classes of labor where before the war female labor if not unknown in this country was almost a curiosity. They depict women engaged in a host of operations involved in general engineering, ship-building, and marine engineering, tool-room and precision work, small arms works, and the manufacture of parts of internal combustion engines. They show them engaged on wiring and rolling mills, operating all kinds of lathes and similar machinery, building small commutators, operating presses for armature work, assembling ironclad switchgear, erecting switchboards, driving 40-ton cranes, in charge of motors on industrial installations, driving electric trucks, electrically welding electric contact mines, operating a 500 kw. switchboard, and attending a 300 kw. direct coupled engine set and a 1000 h.p. steam engine.

Fear and suspicion on the part of male workers as to the position of certain classes of trades after the war, consequent upon the change, still lurk beneath an apparently calm surface; unwillingness and want of conviction as to the suitability of women for certain classes of work still mark the attitude of some employers; and many women continue to show a predilection for classes of service which normal times have proved to be their natural avocations. But we are governed today by the dictates of absolute necessity, and for the time being all will do well to pack up their prejudices, as the soldiers do their troubles, and find a way for doing their bit to further, in the interests of the great cause of Civilization, the employment of women in the engineering factories of the United Kingdom.

If the call of the war office is for men of fighting age and fitness, that of the ministry of munitions is for women, more women, and still more women for our factories in order that those fighting men may do their part with a minimum loss of life, and by hastening the end save millions of treasure also.

Our after-the-war problems may seem to be increased with each successive step forward in disorganization, but who can show suitable alternatives to present methods? Further, may it not well happen that instead of being detrimental to the national industrial situation that follows the war, the availability of a vastly larger volume of skilled and semi-skilled female labor will be an asset of immense value when we resume the manufacturing operations of pre-war times on what we hope will be an exceptional scale, calling for the co-operation of all the demobilized fighting men, and all the new industrial women, in the building up of greater industries than have ever been ours in the past?

WHAT AN ENGINEER CAN DO IN HIS COMMUNITY

In a recent address before the Third Annual National Convention of the American Association of Engineers, Gardner S. Williams, the well-known consulting engineer, in speaking of service the engineer may render, said:

"What can you do?" You can make yourself an influence in your community. Your education entitles you to be a leader of thought among your fellows. Your training teaches you accuracy of mind and body and enables you to analyze propositions and deduce correct conclusions. Your place is in every public assembly, at your party caucus, and at your country's polls on election day. Establish and maintain local organizations, if only in your ward, to bring together the engineers for the purpose of discussing the questions of the day; not merely engineering questions but every question which agitates or interests the citizenship, and when you have come to a conclusion to which you are ready to subscribe, go out and fight for it before the public, in your caucus and at the polls, and let the people know that you are one of two hundred thousand of the best trained, most capable citizens of the republic, who is doing his duty by his fellowmen, by his profession and by himself.

Such service as this on the part of all during these troublous times will aid much in bringing to an early conclusion the present world war.

DEFINITE TIME INTERVAL DEMAND METERS

BY W. A. HILLEBRAND

(Definite time interval meters have found quite extensive application as demand meters throughout various sections of the West. Here is an article that classifies the various meters of this time and discusses their particular fields of usefulness. This discussion is the final instalment of three articles on the subject of demand meters by the author, who is a well-known authority on this line of investigation with the engineering staff of the Pacific Gas & Electric Company. The other two articles were published in the issues of May 1 and May 15, 1917.—The Editor.)

All demand meters of the definite time interval type integrate kilowatt hours over a definite interval of time, and are therefore auxiliary to a watthour meter, on some part of whose register, see Fig. 11, is generally mounted a cam or rachet wheel that actuates

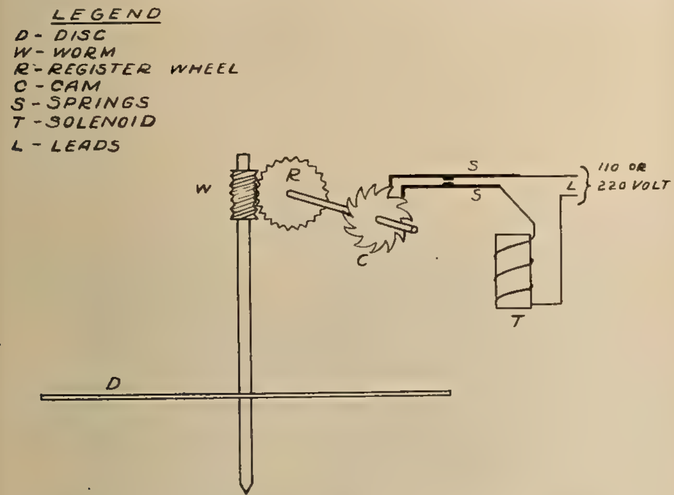
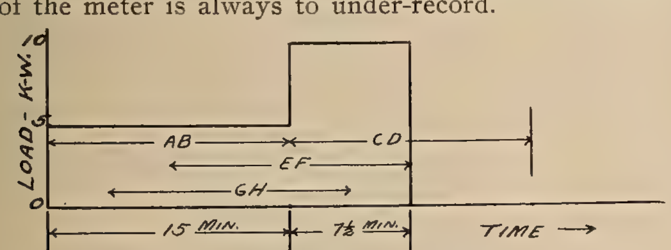


Fig. 11. Attachment to Watthour Meter for Definite Time-Interval Demand Meter

two contact springs. The contact of these springs operates a solenoid T, which operates some form of indicating or recording device, each contact and operation representing a definite number of kilowatt hours. The further duty of the demand indicator proper is to add the number of these contacts occurring in a definite interval of time and to record the maximum of such number.

Nearly all meters of this class have a characteristic fifteen minute load of 5 kw. followed by a steady seven and one-half minute load of 10 kw. which then drops to zero. The fifteen minute maximum is 7½ kw., but the demand meter may record anything between 5 and 7½ kw., according as its interval happens to coincide with intervals AB and EF respectively. That is, only by accident will the interval of the meter coincide with a single peak of duration comparable to the time element of the meter, and, on a varying load, the tendency of the meter is always to under-record.



INTERVAL	RECORDED DEMAND	INSTANTANEOUS MAXIMUM	15 MIN. MAXIM.
AB-CD	5.0 K-W.	10 K-W	7.5 K-W
EF	7.5 "		
GH	6.25		

Fig. 12. Typical Performance of Definite Time-Interval Type of Demand Meter

At very light loads the contact springs may be together for an indefinite period, which unless a special circuit interrupter is provided, keeps in circuit the solenoid T which is intended only for intermittent operation, and is generally noisy with a chattering armature.

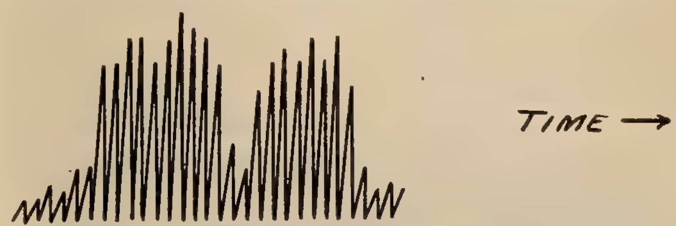


Fig. 13. Graphometer Chart

The indication is subject to the errors of the watthour meter due to voltage, temperature, wave shape, power factor, friction and miscellaneous accidental causes.

The appearance of a group of meters of this class, including the maxicator, graphometer, printometer and General Electric type M-4, is illustrated in Fig. 15.

Printometer.—This recorder, shown in Fig. 15, operates like a stock ticker, the solmoid operating a set of cyclometer wheels under which passes a paper tape. At regular intervals, controlled by a clock, another solenoid is energized, which causes a rubber platen to strike the paper tape, printing thereon a number corresponding to that registered by the cyclometer wheels. The maximum number of contacts is the greatest difference between any two successive numbers printed on the strip.

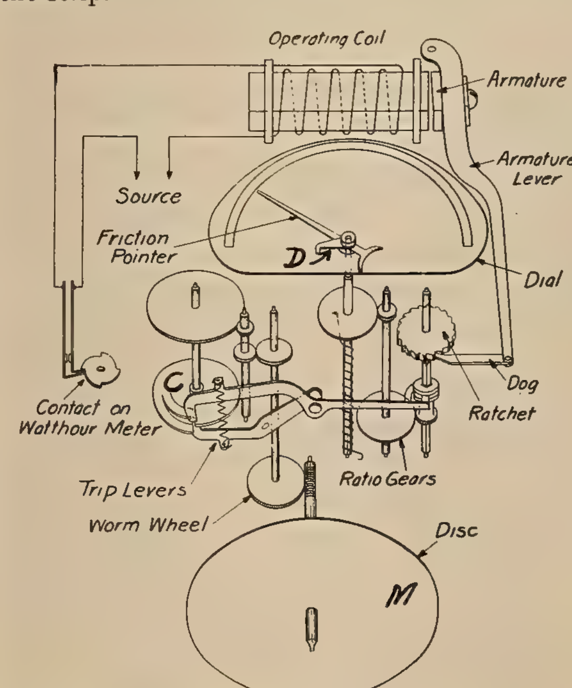


Fig. 14. Plan of Operation of Type M-2 Form AA Demand Indicator

This instrument has the advantage of indicating the day and time at which the peak occurred but is high in first cost, has many parts and contacts and requires time to obtain the maximum reading.

A similar meter is the Ingalls Relay Demand Indicator in which the solenoid punches a hole in the tape for every contact. The demand is obtained by counting the maximum number of perforations in the length of tape travelled during the desired time interval, and the demand so obtained will always coincide with the actual maximum.

Graphometer.—In the original design of this instrument the solenoid actuated a carriage carrying a metal stylus that was carried vertically across a slowly moving strip of paper. At regular periods the carriage would be dropped to the zero position, giving a record similar to Fig. 13, in which the height of any vertical line represents the number of contacts in the preceding period. The advantages of this meter were

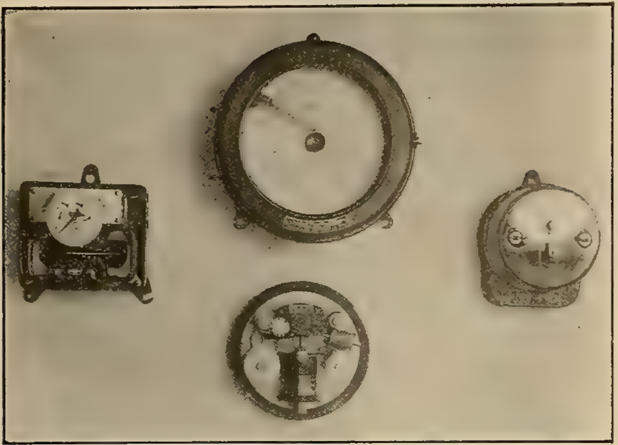


Fig. 15. Typical Appearance of Instruments of the Definite Time Interval Design

a graphic record that was easy to read and slow speed of chart. In this form it is no longer in production but has been superseded by a circular chart design with an eight-day clock, as shown in Fig. 15.

Maxicator.—The maxicator represents an interesting modification of the usual type of definite time interval meter in that, by means of a special register mounted on a standard watthour meter, the disc itself is made to drive a dog which in turn urges a friction pointer over a circular scale. At regular intervals, governed by a timing device, a solenoid resets the driving dog to zero. Its maximum travel in any period is indicated by the pointer, whose reading is proportional to the greatest number of kilowatt hours registered during the desired time interval. The principal difficulties with the maxicator were mechancial, although it is open to the objection that where the resetting of the driving dog is controlled by a clock, a brief interruption of the power supply at the right time will prevent the resetting operation with the result that the registrations of two successive periods are added. The consumer who is wise and unscrupulous can accomplish the same thing and discredit the meter by opening his main switch at the proper time.

The same objection would apply to the various forms of graphic indicator previously described but for the fact that where anything goes wrong with a graphic instrument, the graph itself generally shows the fact and when it occurred. Furthermore, the record previous to the trouble is not destroyed and may serve for billing purposes.

Westinghouse Type RA.—This development is quite similar to the maxicator in that a special register is attached to a standard watthour meter, see Fig. 16, which, instead of moving a pointer over a circular scale, moves a pen over a paper chart. The resetting is done mechanically by the clock that marks the time intervals. Clock and meter are self contained in a single case.

The principal advantage is the elimination of electrical contacts. Possible sources of trouble are due to additional load on the watthour meter, failure of the ink supply, and inaccuracy of clock. The instrument must be visited at least once in seven days to replenish the ink, rewind the clock, or renew the chart.

General Electric Type M-4 Indicator.—This is one of the most widely used forms of demand indicator and was designed as an improvement over the maxicator.

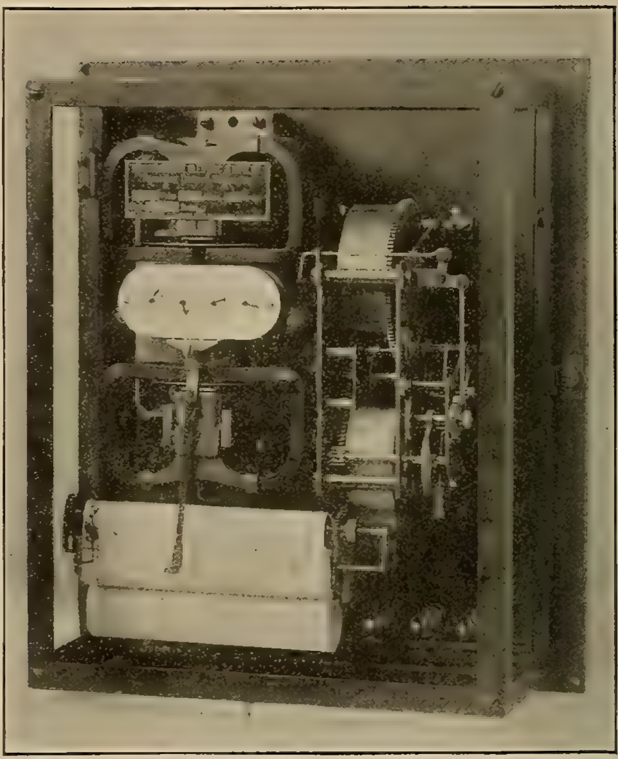


Fig. 16. Westinghouse Type RA Demand Meter

Its particular novelty consists in the fact that the timing device for use on alternating current circuits, instead of being a clock, is a constant speed electric motor, consisting of a copper meter disc driven by a field similar to that produced by the potential element of a watthour meter. It is ingeniously compensated for voltage and temperature so that the speed is remarkably constant under extreme variations in either quantity.

An early type of this indicator, known as the M-2, is shown diagrammatically in Fig. 14. The solenoid through an armature, dog, ratchet and gear train drives against the resistance of a coiled spring a second dog and friction pointer which moves over a circular scale. Resetting is accomplished by the motor, M, which, through a cam, C, periodically disengages the two

ratio gears, permitting the pointer dog, D, to be returned to zero.

Formula

The kilowatt demand is obtained from the registration as follows:

Let K = disc constant in watthours per revolution.
R = register ratio, or number of revolutions of watthour meter disc for one revolution of contact cam on the watthour meter register.
T = number of teeth in contact cam.
C = instrument transformer constant.
D = indicator reading in divisions.
E = time element in hours.

Then

$$\text{kw demand} = \frac{R\,K\,C}{1000\,T\,E} \times D$$

in which D is the statement and $\frac{R\,K\,C}{1000\,T\,E}$ the billing constant applied by the bookkeeper.

This instrument has been widely used, due to the fact that it is inexpensive and is supposed not to require attention. However, troubles with it have been as numerous as the parts displayed, and the writer doubts if they can ever be entirely eliminated, although with intelligent supervision and careful attention this meter is rendering fair service. The remarks made on the dial of the R O meter apply equally well here and the same care should be exercised in securing deflections that are well up the scale.

Owing to the fact that the motor runs continuously, and to the considerable weight of the moving element, bearing wear is much greater than in the watthour meter and diamond jewels should invariably be used instead of the standard sapphire.

Due to inherently different characteristics, meters of different types when placed on the same commercial load will indicate different demands, so that in a very practical sense the recorded demand may be a function of the kind of meter installed. The writer has in mind several such cases, in one of which this difference amounted to as much as forty per cent.

The ideal demand meter would be as simple and reliable as the induction type watthour meter, which is probably one of the most dependable mechanisms ever developed. In rural territory covering hundreds of square miles one man can satisfactorily handle over six thousand watthour meters, but in San Francisco the major portion of one man's time is required to look after about sixty demand meters.

In the foregoing exposition the difficulties with existing meters have been cited in detail in an effort to indicate the problems that confront the man who would design a satisfactory demand meter at a price that the purchaser can afford to pay. The need for such an instrument is imperative, and although no one of existing types is satisfactory under all conditions and for all purposes, it is to be expected that, through co-operative effort by manufacturer and user, dependable indicators will eventually be developed. In justice to the manufacturers, it must be admitted that many of our difficulties with demand meters have been due to the premature introduction of new designs forced by insistent demand of the power companies.

In conclusion, the writer wishes to express his acknowledgments to his associates in the Pacific Gas & Electric Company and in particular, to Mr. Otto A. Knopp, superintendent of laboratory, from whom much of his information has been derived.

RECIPES FOR KILLING FLIES IN CONSTRUCTION CAMPS

Of interest to engineers is any effective method of relieving the fly nuisance in construction camps and elsewhere.

The United States Government makes the following suggestion for the destruction of house flies: Formaldehyde and sodium salicylate are the two best fly poisons. Both are superior to arsenic. They have their advantages for household use. They are not a poison to children; they are convenient to handle, their dilutions are simple and they attract the flies.

A formaldehyde solution of approximately the correct strength may be made by adding 3 teaspoonfuls of the concentrated formaldehyde solution, commercially known as formalin, to a pint of water. Similarly, the proper concentration of sodium salicylate may be obtained by dissolving 3 teaspoonfuls of the pure chemical (a powder) to a pint of water.

Any odor pleasing to man is offensive to the fly and vice versa, and will drive them away.

Take five cents' worth of oil of lavender, mix it with the same quantity of water, put it in a common glass atomizer and spray it around the rooms where flies are. In the dining room spray it lavishly even on the table linen. The odor is very disagreeable to flies but refreshing to most people.

Geranium, mignonette, heliotrope and white clover are offensive to flies. They especially dislike the odor of honeysuckle and hop blossoms.

According to a French scientist flies have intense hatred for the color blue. Rooms decorated in blue will help to keep out the flies.

Mix together one tablespoonful of cream, one of ground black pepper and one of brown sugar. This mixture is poisonous to flies. Put in a saucer, darken the room except one window and in that set the saucer.

To clear the house of flies, burn pyrethrum powder. This stupefies the flies, but they must be swept up and burned.

Borax is especially valuable around farms and out of doors. One pound of borax to twelve bushels of manure will be found desirable as a poison without injuring its manurial qualities or farm stock. Scatter the borax over the manure and sprinkle with water.

Lye, chloride of lime, or copperas (sulphate of iron) dissolved in water, crude carbolic acid, or any kind of disinfectant may be used in vaults.

STATISTICS ON WATER USES IN CALIFORNIA

The first report of the State Water Commission, which is just from the hands of the printer, covers a period from March, 1915, to December, 1916, a little less than two years. Among many other things, it shows that agriculture tops the list for use of water by the overwhelming percentage of 93 per cent of the total amount applied for. Power represented 5 per cent, mining 1 7/10 per cent and municipal supply 3/10 per cent.

A NOTEWORTHY SYMPOSIUM ON RATES

(The subject of rates, whether charges should be on the basis of straight meter measurement or on a flat rate basis or a combination of the two, has long been a perplexing one throughout the West. Here is a discussion participated in by a notable gathering of engineers and central station men of the West that adds much to our present knowledge on this important subject. This symposium on rates as detailed below is the stenographic report of the discussion on this subject in the commercial section of the Pacific Coast Section of N.E.L.A. at the Riverside convention, April 19-21, 1917.—The Editor.)

S. V. Walton: Mr. chairman and gentlemen of the convention, in preparing the report of our committee for presentation at this time, and following the suggestion of President Ballard, I am going to make my remarks very brief. I felt that I had to make a few excuses for the report for myself and for the other members of the committee, but after hearing the very complimentary remarks of Mr. Ballard and the suggestions followed up by your secretary, Mr. Halloran, I won't make any excuses, in fact I feel rather proud of our report.

It is pleasing to me as one of the younger men in the business, one who has devoted all his business years to commercial work, to be given the first paper on the program after the introductory remarks. There is no doubt in my mind that the commercial end of the business is of the greatest importance, has been for some time, and will continue to be more important as time goes on. The first time I was particularly struck with that importance was at the meeting of the National Engineering Congress held in San Francisco in 1915. At that time Mr. F. G. Baum, who is well known to most of you as a technical electrical engineer, presented a technical report, supposedly. That technical report, however, was really a broad commercial report. The keynote of the whole report was the statement made by Mr. Baum that "the civilization of the future will be measured by the number of kilowatt hours consumed per capita." If what Mr. Britton has told us today is true, and I never heard anybody say that he said anything that was not true, California is one of the most advanced states in this country, because here we have the largest consumption per capita of electrical energy of any state in the union.

It is particularly interesting to me at this time to see in the room representatives from all the western states. Not only have we representatives of our own section, taking in the states of Nevada, Arizona, California and New Mexico; but we have a representative of the Northwest Electric Light & Power Association, taking in the balance of the Pacilc Coast states, also Montana, Idaho and Utah. That man comes in as a representative of that section. His size of body and size of mind entitles him to represent all the states in that section.

It is not my purpose as chairman to bore you with the reading of our report or any portion of it. Thanks to the Journal of Electricity it has been printed and distributed prior to the time of our coming to this convention.

For the purpose of handling the subject in as brief a time as possible, our committee felt it advisable to divide the subject up. We assigned the sub subjects to different members of the committee who we felt were qualified to handle them, and in that order the subject of Rates was given to Mr. Lemmon. To supplement that, there was a demand for a paper on rates by W. G. Vincent as a rate expert, and he kindly agreed to prepare the paper. The subject of Merchandise was turned over to Mr. Childs of the Southern California Edison Company, a man qualified by experience to handle the subject properly. Electric Heating and Cooking was delegated to Mr. Black of the Great Western Power Company. Unfortunately he is not here. The subject of Industrial Heating was turned over to Mr. Holloway of the San Diego Consolidated Gas & Electric Company of San Diego. To Mr. Walthall of the San Jose Light & Power Company was given the subject of Highway Lighting. The subject of Commercial Organization was handled by Mr. E. B. Criddle.

The recommendations by our committee have been mentioned by Mr. Ballard, and I want to refer to one of them again,—co-operation with other than central station men in our section. It was interesting to me to note on the train that more than fifty per cent of those on the train were representing contractors, jobbers, dealers and manufacturers, and less than fifty per cent representing the central stations. A pleasing thing was the large attendance of members who came from the California Association of Electrical Contractors and Dealers. Their president came down and you will get acquainted with him. They are supporting this plan 100 per cent, and show that we here on the coast are on the right track and possibly a little in advance of the eastern fellows.

I am going to read a paragraph from a letter received the day before I came away, from Mr. Edkins, chairman of the commercial section of the National Electric Light Association, who has also just been appointed chairman of the committee on co-operation between the National Association and the Electrical Supply Jobbers' Association. That meeting was held in New York last month and as a result this committee was appointed. Mr. Edkins says, "It is generally regarded as a milestone in the history of both associations, as this was the first time that representatives of the two bodies had ever met for the purpose of establishing a closer relationship." I think that means a good deal in the industry.

I don't think we can say too much in a complimentary way of the Journal of Electricity, which has done so much in bringing this convention about and making it a success. Without going into personalities, you all have seen the last two numbers of the Journal, the April 1st and the April 15th numbers. You have also received a little baby Journal containing a program of the convention, a few photographs of some of the leading men in the section, and a list of the committees, and also a list of all the registered members. The little leaflet is of great value. I am told they are getting out a daily paper, copies of which will be on distribution tomorrow and Saturday morning, telling about the succeeding days of the convention.

In connection with the discussion of papers, on account of the limited time and to prevent the discussion going wild, it has been thought advisable to limit the discussion of any member to five minutes. Some can say a good deal in five minutes and some cannot say very much. At the end of five minutes of discussion by any member I am going to call time; and if there is a popular demand to give him more time, we will let him go on and say more. Also, those who wish to discuss the paper, should come to the front, because if what you say is of enough importance to be said, we want the reporter of the convention to get it for our proceedings. Each speaker should state his name and the name of the company with which he is connected and also his place of business. That is all I have to say in presenting my report.

President Ballard: Chairman Walton of the Commercial Committee, the meeting is now yours. The time of the session may be extended as long as necessary after five o'clock but not later than six.

Chairman Walton: Now, if any of you want to throw out any of the engineers, it is time to tell them to go out while the going is good. I don't see anybody rushing out. The first paper on our program is a paper on Rates by Mr. W. G. Vincent, Jr., of the Pacific Gas & Electric Company, San

Francisco. The paper is printed in full in the April 15 issue of the Journal, and I am going to ask Mr. Vincent to briefly abstract the paper, and, in doing so to start the discussion.

(Mr. Vincent thereupon presented his report as heretofore printed on page 278, Journal of Electricity, April 15, 1917).

Rates

H. F. Jackson: Mr. Chairman, it strikes me that Mr. Vincent has made an excellent point in emphasizing the two phases of this problem, namely: the theory of rate making as distinguished from the rate itself which is to be handed the consumer. Many of our troubles have arisen from the fact that our rate schedules partake of the nature of formulae in which there are a number of variables which are to be determined for any particular load, and when determined and substituted in the schedules or formulae give the rate per kilowatt-hour applicable to the load in question. What the consumer wants is a simple rate per kilowatt-hour or a block system rate per kilowatt-hour. It is, of course, not possible to quote general rates per kilowatt-hour for all classes of load because of the varying effects of fixed charges, per customer charges and operating charges, but it would seem that we had been leaning too much in the other direction by embodying more or less of the theory of rate making into the published schedules. Every particular case could be analyzed on the basis of the cost of generation, cost of transmission and of distribution, and general expenses, embracing fixed or variable charges dependent upon demand and energy consumption, but the result, while perfectly fair throughout, would be a different rate for almost every consumer and would involve so much computation that we would never serve many customers. It seems to me that most of the essentials could be taken care of, however, by having the rate experts of the various companies classify the business and compute a general block rate for the average conditions of each class. In other words, let the rate experts consider the variables and determine a general rate for the class, which rate would appear in published schedules as a straight kilowatt-hour rate or block system kilowatt-hour rate.

The objection to this lies in the variation of particular customers from average conditions, complicated in some cases by competition from other sources of power, and in others by the presence of an existing isolated plant; or in charges of discrimination between different classes, but, assuming as we must, that the expert will determine the classifications and rates upon the facts without any bias, it seems that the added simplicity of the schedules would more than offset the disadvantages.

John A. Britton: May I say a word? It seems to me that Capt. Jackson is right and Mr. Vincent is right on the question of difference between the theory and practice with consumers, and the reason is this: The consumers of electricity per se, are few who have not been consumers of gas. For over a hundred years gas has been delivered to consumers on a straight meter rate basis, and it has never failed of doing what it started out to do—to accommodate the desire of the consumer to take that commodity. In the first beginning with electricity we did not have any fixed rates. We charged whatever the traffic would bear when our first arc lamp was introduced. Subsequently when meters came into use we adopted a straight meter rate, not knowing anything of the diversity of the uses of electricity. It seems to me that the whole trouble rests in the fact that at the time when the diversity factor was unknown and the load factor was a negligible quantity, that engineers began to study some way to confuse the public by the introduction of rates which the public could not understand and which they themselves very rarely understood after they had made them. (Applause). I made some myself. (Laughter). Now, there was the trouble. As the diversity factor created a better load, the necessity for a rate based upon demand gradually passed away. I think we will get out of this domain of high science and theory and come down to practical facts and we will accomplish a great deal more for our own benefit. In other words, I mean to come back to that question of a straight meter rate. We could not do it with gas if we did not have storage capacity. But when we contemplate the storage capacity of our gas plant as compared to its total daily output, it bears no different relation, to my mind, to what electric companies are able to do today by reason of diversity and the high load factor now being attained, and, I think, the study of the minds of the men who devote time to rate making, would relieve, at least, the companies, and would relieve the commission from a great deal of embarrassment.

Chairman: Reference has been made by Capt. Jackson and Mr. Britton and also by Mr. Vincent to the commission in rather an indefinite way. Those gentlemen living in California refer to the California Railroad Commission. The other states have other commissions. We have some representatives here of the California Commission, and I will call on Mr. Ready of the California Commission.

L. S. Ready: I have not much to say. There is one thing however, I would like to say about the rate schedule. Mr. Vincent mentioned something about their often not being intelligible to the consumer, especially as they are written. I have had the duty of reading over a number of rate schedules in the last several weeks, trying to get some idea of a uniform schedule, and I almost agree with Mr. Vincent. It is quite hard to understand a number of them. Each company has a different way of stating its schedules. Some of them put a great deal more information into the schedule than is necessary; others do not put in enough. I hope that we can work together to get a standard form of schedule which will be as concise as possible, and, at the same time, as inteligible as possibe to the consumer.

A schedule of rates, in my opinion, should be for the information of the consumer. Quite often the solicitor or salesman of a company does not know about the consumer's power requirements and the consumer does not know all about the rate schedule, and the consumer of power, especially, often fails to get the information necessary, in some cases due to the fact that there is so much in the schedule that he never reads it over. I think we can make these schedules a good deal more concise and explicit than a number of them now are and thus assist in giving the information to the consumer. I would say that at least an average of 75 per cent of the consumers of any company are lighting consumers, and one or two schedules is all they are interested in, and they never look at the other schedules. The big difficulties arise really in the power schedules.

Referring to the question of agricultural schedules, it seems to me that we must change to "agricultural schedule" as against the old use of the pumping schedule in order to make the irrigation power business pay. In most of the districts, except where it is used for continuous irrigation, and especially in such districts where the rainfall is from 15 to 20 inches, electric pumping service is an insurance and not a strict pumping proposition. Companies must encourage other business than the pumping load to make the irrigation or agricultural load pay enough to justify its extension. I think future work should be along the line of developing agricultural schedules which will apply to all possible power service on the farm and will make agricultural service a remunerative proposition.

Chairman: The discussion so far from member companies has been from the representatives of what we term larger companies. As brought out by Secretary Halloran, the majority of the membership is made up of smaller companies. There are a great many members that do not live in California. I am going to call Mr. Aller, general manager of the Pacific Gas & Electric Company of Phoenix, Arizona.

H. L. Aller: I sympathize with Captain Jackson and object to being called upon without any preparation. We have had much the same experience in rate making and have followed almost the entire cycle that Captain Jackson

has outlined. We have gone from the simple rate to the complicated rate and have turned back again to the simple rate. When we take into consideration the fact that about 80 per cent of the consumers of the normal electric utility are small consumers, it becomes obvious that to inaugurate a complicated 2 or 3 factor rate for all classes of consumers is merely to court difficulties without any compensating advantages. I believe that if we endeavor to establish a straight meter rate without any demand factor, for all residence consumers and, in fact, for all small lighting consumers, and establish the demand factor and more scientific rate for the large power and lighting consumers only, we will dispose in large part of our difficulties.

We now have a very simple two-block rate for residence consumers and a simple four-block rate for small business lighting consumers without any demand factor. We have an alternative lighting and power rate with a demand factor for large business lighting and power consumers. About 75 per cent of our small business lighting consumers are on the simple block rate.

Prior to the time that we established this simple rate we had endless discussions with the small consumers, trying to explain the equity of the demand factor rate. Since the small consumer prefers to pay his bills under an easily understood rate, he should be accommodated, even though we feel that a slightly more equitable distribution of costs could be effected by a more complicated rate. I believe the time is coming when we will all follow Captain Jackson's cycle and revert to simpler forms of rates.

Chairman: As I said in my early remarks, we have with us a representative of the Northwest Association, I will call on Mr. Coldwell to discuss the question from his point of view.

O. B. Coldwell: Gentlemen of the convention, it looks like this is a put up job. Regarding this matter of rates, in the Northwestern Association we, too, have had numerous papers on the subject and have possibly traveled the same journey which Capt. Jackson mentions. There is one phase of it which we have gone into somewhat and which has not been mentioned so far, and that is the attempt to ascertain some of the fixed charges applicable to the various classes of service, and to ascertain the total cost with the object in view of submitting rates to those costs. I cannot say that our endeavors were altogether successful, but it appealed to me that there is a field there for an engineer which is well worth while. The average central station man, I think it will be found, if the question is put to him as to what it is costing in toto to serve the various classes of service, especially if his company happens to be a combined light and power and railway property, is ready and quite ready, ordinarily, to talk about the matter of operating costs. He knows about those things very well indeed. When it comes to the other part, that is, the fixed charges, he is at a loss and the best he will ordinarily do is to give some approximation. In other words, the matter of apportionment of cost to the various classes of service is something with which he is not altogether familiar.

The commissions have done some work along these lines. It seems to me that it is high time for the central station people to undertake themselves to solve this problem. It certainly has an intimate bearing upon what rates should be. I believe the central station people could very well try to set the pace in that regard rather than follow the commission and the commission's engineers. It goes without saying that the operating men who are actually in the business are better qualified through their intimate knowledge of their operations to carry out such apportionment, than is the engineer of the commission who is handicapped by not knowing the intimate use to which the property is put.

Chairman: I only believe in a modified form of conscription, and unless there are volunteers for further discussion on rates, I will not call on anybody else other than Mr. Vincent, if he wishes to say anything further. Mr. Vincent, would you like to say anything further in closing?

W. G. Vincent: There are one or two points that I would like to bring out. First, I am not advocating a complex schedule or any complicated scheme of rates. I think that at the present what might be called the standard bases of charges which are in use, such as the Hopkinson, Wright, block rates, etc., are sufficiently flexible to take care of any problem or any form of rate curve that may be desired. Second, in regard to Mr. Aller's remark that one consumer possibly pays a little more and another a little less than they should, I believe that this is inherent in any rate schedule. The best that any schedule can do is to approximate an equitable distribution between classes and between consumers and we cannot hope by any general schedule to obtain an absolutely equitable distribution between all individual consumers.

The straight meter rates which have been referred to by several of the speakers may solve your problem from the commercial point of view to a certain extent. I believe, however, that the speakers who have referred to a straight meter rate have not intended to be understood as approving a rate carrying the same charge per kw.-hr. for all consumption, but rather have meant to be understood as charging a rate based entirely on the kw.-hr. used. This, of course, would include block rates. This class of rates used exclusively will not give consumers the opportunity to make the greatest use of our service nor will they permit the greatest possible use of our plants and equipment. These results can only be accomplished by the use of differential rates in one form or another.

H. F. Jackson: May I intrude just a moment longer? It seems to me that if one thing has been pointed out by this brief discussion, it is the fact that we have a very large subject to discuss. It is one to which we can devote a great deal of study. The interest which has been shown would seem to me to indicate the advisability of our getting together in local groups when we get home, to work on this rate problem and to develop something that can be brought back as a basis for further study by the association. I would like especially to urge that the people from San Francisco get together and talk frankly. They can spend hours on the subject. Let them get the essentials together and see if we cannot from the combined experience of all of us build up something simple enough for the consumer and yet embodying the various elements of fixed and operating charges.

C. F. Butte: I would like to ask a question from the standpoint of a consumer in reference to power installations. Many times we install them and it is hard to get the consumer to understand the minimum rate per horsepower for motors connected. Is there anything in regard to that subject to be taken up, on the minimum charge per horsepower? Many times we will install a larger motor than is absolutely necessary for intermittent service. As an illustration, in a mill we installed some time ago, the minimum rate used at that time was greater than the consumption of the entire mill, and the minimum per horsepower connected was reduced for that reason.

Chairman: Mr. Butte is the president of the Butte Engineering & Construction Company of San Francisco, and an electrical contractor, and one of the members of our association. This particular question is of vital interest to contractors. Has anybody anything to say in answer?

A. G. Wishon: Especially in view of the character of load that is carried by a company like mine, it makes a great deal of difference whether we have a straight meter rate without reference to installed capacity, or whether we have a minimum charge first. I do not think that I would object to a straight meter rate, provided there was sufficient minimum charge. I once had a canvass made along a line out of Fresno, that had eighty-two gasoline engine pumping

plants within a mile of either side of that line. We went so far as to find over a term of years the number of hours that these engine plants had been used for pumping water for irrigation, and found that it was only a few hours each year; that they were not put there to be used except in extreme emergency. They were there as standbys for possible dry years for the Fresno Canal & Irrigation Company —one of the most dependable water rights in the state.

Now, if we go to a straight kilowatt hour basis, without any reference to a standby charge, we are going to face a fixed charge upon the investment in transformers and our lines to reach these people, without any assurance whatever of an income except in dry years, being exactly the time when we are shy of sufficient water for our own operation. Take, for instance, the dry years of 1912 and 1913, when our reservoirs were barely full and our streams were almost dry. If we had been taking on that kind of business, our maximum demand would have been doubled and the very next year would have shown no income from that class of business. We would have stood there as a guarantor for the ditch companies, with a fixed charge that we must meet, without a dollar of income. This is a very serious problem that must always be considered.

On the 1st of January, 1916, 26 per cent of our business was agricultural pumping. I know one of the companies in the state that had more than three times that percentage of that class of business. It will, therefore, not do to undertake to handle that business without a suitable minimum charge as a consideration for fixed charges that the companies must have for service rendered. I once said to a member of the railroad commission—"do you realize that it is just possible that no two companies in this state need of necessity have the same rate? Take, for instance, a company with one class of business predominating, it should have a certain rate to accomplish a certain general result. If any company has a great diversity of business, it can stand nearly anything from any one class, but it could not be be done with the kind of business that we are serving."

I think most of us have overlooked the value of the diversity of our business. Like Captain Jackson, I am willing to back up a little on my theory of this feature. I am even willing to go so far as to say that an established flat rate system is really not a flate rate, but a charge for a maximum demand, which might be superseded by a minimum standby charge and a plus charge for kilowatts used, but the minimum charge must not be too small; for you must have a sufficient sum to cover your investment, operating expenses, and a reasonabe profit, whether they run or not,—something like the insurance companies. They charge a flat rate for the insurance of your property, which many suppose to be a profit of one hundred per cent in the event your property does not burn, but which in fact is a collection of a sum representing the cost of writing that particular class of business and carrying it for a fixed and definite term. We must certainly have a satisfactory annual income as a standby.

When you get away from that feature, my company and other companies with which I am acquainted will suffer greatly. The Pacific Gas & Electric Company, with its big commercial and industrial business, consisting of lighting, mines, dredgers, reclamation, and all that sort of work, gets out of it on diversity factor that makes the results reasonably satisfactory, notwithstanding that one of the items of their business, for instance, reclamation, is a very uncertain quantity. I know of the operation of pumps by that company of very large units, where the business is very intermittent

If such units were operated in the way that they are operated on the islands by a company with the load we are carrying, it would break it. They may have enough other business, however, so that they can stand it because of their general diversity factor, but the percentage of such a load to our total would be fatal to us. So I say that this proposition must, in a way, be approached from the needs of each company and the class of business served by it. We cannot get away from that theory. When I first started in the electric business, twenty years ago, I conceived what I considered the bright idea of charging an annual sum for a fixed maximum demand. If the consumer took a definite part of our installed capacity, the rate charged him was based upon the cost of operation, interest, depreciation, and a small profit on that quantity of our capacity, and he was given the privilege to use it continuously—a thing that the early users of pumping plants accepted in the orange districts.

That worked out pretty well, because we had practically one class of business. We probably did not have more than ten per cent of all other classes combined.

As the San Joaquin built up a diversity of business, we modified this plan by giving seasonal irrigation rates, because the pumping load in the summer time and our lighting load in the winter time were offset. These seasonal rates were also based upon load factor. This whole system seemed complicated, it is true. We tried our best to teach the consumer how the measurements were made, but it was a hard game. Our whole system of commercial and industrial rates were based upon load factor.

In fixing all of our rates the commission did not see fit to leave us this scheme of determination. They based the rate upon a different theory, some of which worked out all right—other parts of which we persuaded them to allow us to change, so that the proposition is at this moment unsettled as to which of the two plans were most satisfactory. But the commission's scheme of rating has the advantage of having the official stamp of the commission, whether right or wrong, and automatically satisfies most of the consumers.

There is this one feature that I hope for and I think the commission will finally come to it, and that is that there is a classification in business that must be known and understood as classification instead of discrimination. The commission accused us of discrimination. I honestly do not see it that way. I firmly believe it to be classification. It is my hope that we may be able to impress upon the experts of the commission the real existence of classification.

All tons are not the same price per ton mile with the railroads. I had an experience in the shipment from a little town near Fresno of lumber at 75c a ton and gravel at 25c a ton in the same class of cars—shipper loading and unloading in both instances. This is classification—pure and simple—well understood by me and, seemingly, by the country at large, because it is an ancient and well understood principle, while the development of the electric business has been more recent and the theories of development have been so varied as to really muddle the subject.

This condition has been brought about by each company having a different theory of rating, there being no standard of hardly any one rate applicable to all companies. The experts of the commission thoroughly understand the classification of railroading, and it is my sincere hope that they will help us to study out classification in our business, realizing the effect upon our systems of the demands of different classes, at different seasons of the year, or different times of the day.

I do not believe that we will ever be able to serve one hundred per cent of all existing business in any district. There are certain standbys that are intended as an insurance against dry years in gravity irrigation districts, that positively will not pay the power companes to handle, some of which are not run one year in ten. I sincerely hope that a study will be made of classification of rates and a solution arrived at as to the difference between classification and discrimination, for it is an important and controlling feature.

John A. Britton: To set myself right, in speaking of the straight kilowatt hour, I had no idea of departing from the

minimum charge for any service at all. That would be a practical impossibility even for us to do.

Chairman: I think the question propounded by Mr. Butte has been side-stepped. His troub'e, I think, is where a man installs 75 horsepower and where 50 is all that was necessary, —that he wanted 75 horsepower but would not pay the minimum.

A. G. Wishon: In our business of irrigation, for instance, we have a section of the country with about 400 pumping plants installed where the water goes very deep after the pumping season begins. The recent rulings of the commission were to the effect that we should have a fifteen minute maximum demand to determine the basis of charge for the power used. Now, in our old scheme of maximum demand we did it in a different way, allowing the pump to operate for a few hours until the water level was down to a normal condition, when we then took his maximum demand. In some seasons of the year, it might take us six hours—in others, a shorter period. After the running conditions were determined, measurements would not be taken again until the beginning of another season, when the water level would be higher and the pumps inclined to overload, unless allowed to pump off the top, as stated. In other words, we did not measure except under running conditions.

This same plan was followed with reference to summer business, as in the flour mills, where the journals must be warmed before the heavier starting torque is over. We never did charge them under our old system of maximum demand rating for the conditions under which they were started, but on the other hand, we charged them for the running conditions. In the oil fields the maximum demands occur several times during a day, from thirty minutes to an hour, that makes an unsatisfactory method of determining their rates under the maximum demand rulings of the commission. I think we should be permitted to measure this class of business under the operating conditions without calling it discrimination. We again insist that this is classification—in some instances, a physical condition that cannot be determined by the "rule of thumb."

Chairman: Does that answer your question?

C. F. Butte: The object of the question was to bring out a point in connection with preliminary work where we don't know the exact amount of the prospective load. In several cases we have found that the minimum rate per horsepower for the meter exceeded the consumption during the month. Whether that has been changed or not I don't know. That was my reason for asking the question. It applies more to industrials than to pumping plants.

Chairman: I think the question raised by Mr. Butte is a very interesting one and one that every company has to solve for itself. It is classification.

John A. Britton: I feel apologetic for butting in again, but this is such an important and such an interesting subject that I can't help it. I have run against exactly the problem Mr. Butte is talking about, and it is this. We have had what we considered the most ideal rate, the load factor rate. We have run into the question of a man putting a motor in and penalizing him by reason of his having a little more machinery. That points to a moral. That is the point that we want to get at here. That is the reason why we should come to some kind of a meter rate that will take care of the general situation. It won't be the business of A, as Mr. Vincent has pointed out, or of B. There will be slight discrimination, but on the whole it will be the fair thing. Speaking of the lighting question in the town, all the consumers in the town ought to pay the same rate for the same service, whether they live in the outside of the town or in the center of the town. I mean based upon the rulings of the railroad commission as made and probably upon equity. Therefore we should have something that will get away from this class discrimination of connected load when a man has not the connected load working. I wanted to say that Mr. Wishon unfortunately misunderstood what I meant. We have no idea of relieving the consumer of the minimum charge. What was in my mind was hitched onto the point Mr. Butte has made, namely, by reason of the fact that a man has installed ten horse-power more than he needs he should not be penalized more than the fellow who happened to hit it exactly.

Edward Whaley: I do not reach the same conclusions as Capt. Jackson. A straight kilowatt hour charge cannot equitably meet all conditions of service if it is admitted, as I think it should be, that cost of service, including a proper return on the capital invested, should determine what is a proper charge for service rendered by utility. For example, a minimum charge which exceeds the bill as computed for the number of kilowatt hours used at the straight kilowatt hour rate is conclusive proof that in that particular case the straight kilowatt hour charge has failed to correctly measure the value of the service. If you analyze it closer you will find that the straight kilowatt hour rate will theoretically meet only one condition out of the many that will arise, although it will approximate a great many others. Standby, or readiness to serve charges, which are eminently proper, are practically ignored by the straight kilowatt hour rate.

In the matter of classifying your service and applying a proper rate to each class your problem is no different to that of the man operating a department store. If you will analyze your business sufficiently you will find that you are in the same position as the department store manager who discovers that a dozen departments are making a satisfactory profit but that two or three are making a loss each year.

Mr. Coldwell has pointed out what, to me, is our real problem. We have got to study our business more closely than we have in the past, we have got to take it apart and analyze it closely in an endeavor to lay a proper basis for the classification that Mr. Wishon wants. And this matter of classification, within reasonable limits, is of the utmost importance. A proper classification is the only insurance against discrimination. If you do not properly classify your customers but arbitrarily put them all in the same class, the result is the very essence of discrimination, for the large majority will not pay in proportion to the operating conditions which they create.

Mr. Aller has raised a point which must not be overlooked and that is, that analyze the conditions as closely as we may we finally come to a point beyond which it is not practical to multiply our classifications and that here we have to resort to a study of the average conditions within each classification. Extreme care should be exercised in doing this part of the work, however, for in applying the law of averages to the operations of a large company with a great many consumers in order to determine the results of applying a given rate to any class of consumers the actual results will vary greatly from those in the case of a small company with a limited number of consumers and wherever possible a separate check should be made on a number of individual cases to determine whether the conditions assumed to be average are truly so or only apparent.

A few other points come to mind in this connection. I have nothing to say on them but I wish that some one else would. That is, the value of the service to the consumer and, going very closely with that, the rate necessary to meet competition of some other sort of power.

Chairman: The subject of rates is so big and of so much interest to all of us that we could sit here and discuss it for weeks. The question raised by Mr. Butte is interesting. The fellows of the commercial end of the business are confronted with it every day and a number of times a day. Mr. Britton says that Don't Worry Somers wanted to speak on the subject.

Frank Somers: Along the line of least resistance of making the rates more intelligible to Mr. House and Lot, to whom I sell ranges, we speak of the rate of 4, 2, and 1½ on

active connected load. The average range is 5½ kilowatt. In trying to make ourselves understood by the country customer to whom we are obliged to sell ranges when we cannot sell them gas ranges, we tell the old man that the rate is 4 cents, 2 cents, and a cent and a half,according to the amount he uses, and that the range is 5½ kilowatt, and we arbitrarily place the load at 3 kilowatts active connected load. The active connected load means that the average is only going to be half of the range rate. I know two consumers that live in the country where I do and have the same kind of a range, put in by the same man and put in right—well, no,—I put it in. (Laughter). One of these ranges averages $2 a month. The neighbor has an average of $8 to $8.50 a month. They cannot understand why they pay the same rate. One is practically a retailer and the other a wholesaler. We even try to explain how we arrive at that decision of 5½ kilowatts when the active connected load is 3 kilowatts.

Chairman: Our president has told me that if I did not stop the discussion on rates and get to something else, he would use the big stick on me. But Mr. Kennedy wants to talk and I wouldn't dare stop him.

S. M. Kennedy: I have been listening carefully to what has been said on this most important subject. I believe there is no subject that the commercial man has to deal with that requires more detailed attention than the one of rate making. We talk these days a great deal of scientific rates. As I understand it, that means fixing rates that closely follow the cost. Now, the most scientific schedules that I ever saw were in a certain city in the east. They took into consideration the connected load, the maximum demand, the load factor, the hours of use, and the quantity, and also allowing something for cash payments. I made it my business to go to that city to study that condition, and I had nothing but admiration for those schedules. They were the most beautifully constructed schedules I ever saw, and, as far as I could see, they followed the cost more closely than any other schedules I have studied. At that time I was making a special study of that subject.

But I found something else. After I had studied the schedules in the offices of the power company, I then went out and talked to some of the power company's consumers on my own account. I said I was a stranger from the coast and inquiring about business conditions, and worked around to the subject of rates. I learned there was not one satisfied consumer out of 50 business men that I talked with. I learned that those schedules, which the power companies claimed to be scientific, and while I recognized that they were scientific, it was a fact that they were a trouble and a worry and a cause of soreness, and one of the evening papers was regularly pounding the power company because people complained they did not know what they were going to pay for the energy they were using.

Now, I want to tell you what my conclusion is after sixteen years of this rate-making. I find that it is better for the consumer—it pleases the consumer—and it is better for the power company and it is better for every one concerned, to have a simple schedule. The more simple the schedule can be made, the better it is. We may make schedules that are scientific and follow the cost closely, but we are going to have a great deal of trouble with them. I saw some schedules filed with the railroad commission that would take a Philadelphia lawyer working overtime to analyze and find out from them what the rate for service was. And that is not what the consumer wants. We want to simplify the conditions so as to get the business, and the way to get business is to meet the reasonable wishes of the consumer.

Now, I want to point out another thing. The same rate conditions applying to a small company do not apply to a large company, and what applies to the big company does not meet the requirements of the small company. The reason is the diversity of the load. Nothing has surprised me so much during my long experience as how low we can go with some consumers and how much it costs us to serve others. We must pick and choose between the different classes so that we know the value of the different loads. We must also take into consideration the question of expediency in competition. We must figure on the details of each kind of consumers' business. To a considerable extent, while we may pick out the large consumers and give them special rates and put them in a class by themselves, we must keep our schedules simple and we must learn to take the lean with the fat. We must make it easy for the consumer to understand, and at the same time we must get all the business we can. The large company with a great diversity of its load needs all classes of business. I would take the kind of business Mr. Wishon says he does not want. I would have some kind of system that would take that business on, if it is only seasonal and if it needs service only one year out of four, because of the diversity of the load of my company. The more diversity we have in the load the more we can classify and the more readily we can take on all kinds of business. I don't know any kind of business in Southern California that we want to push to one side and say we don't want it. My company wants it all and we are going to get it all and we are just learning how to get some that we never have reached up to now.

W. S. Leffler, (contributed): I fully appreciate, from the standpoint of gross station revenue, the relative importance which electric heating and cooking rates bear to the power rates, upon which we have just heard such interesting discussions, but before passing on to the next paper I would like to hear some discussion on the very pertinent questions asked by Mr. Vincent in his paper, under the section of electric cooking and water-heating rates.

The questions are: What form of schedule is best? Shall we make a one-meter rate in combination with the lighting load? What shall we make the top rate? Are we justified in making a lower rate for this service than for small power? How can we handle water-heating? .

The first question, asking what form of schedule is best: Several years ago, as Mr. Jackson has said, we were at the ultra scientific extreme in our rate analysis and development. Today we are realizing our inability to make rate experts out of our consumers, and are swinging back to the old unscientific, though simple-in-explanation, forms of schedules. Let us not swing too far, because in the meantime we have come under the regulation of a commission whose sole duty is to expert rates, and though I fully appreciate the advantage of the simple rate-forms, still I am of the belief that we can yet develop a form of amplified domestic service rate so simple in its quotation that the consumer may readily comprehend it, yet sufficiently scientific in its nature to induce the consumer to impose upon us only such load characteristics and investment requirements as will entitle him to the low unit rates quoted in the last blocks, and therefore make practicable the operation of that type of cooking and water-heating equipment which will amplify our domestic feeder revenues to the point where the investment thereto dedicated will be developing a net profit as great per unit of load as is derived from other classes of service.

If from the nature of today's discussion we are to conclude that the simple block form of rate will be most generally acceptable and effective, I should wish to point out the value, and, in my mind, the necessity, of considering the consumer's total load, at least to the extent of having the resultant rate quoted in the form of two block rates, each of similar form but applying to a different size of connected load, and so designed as to derive for the central station a gross revenue in direct proportion to the investment necessary to serve the various size loads. A schedule such as the following, is, in my estimation, the simplest form of scientifically-sound rate which can possibly be quoted.

In the following rate-form the unit charges are naturally subject to modification for adaptation to each central station's conditions:

Amplified Domestic Service Schedule for Application to Domestic Lighting, Cooking and Water-Heating Installations

Part I

Where consumer's total connected load does not exceed 7.5 kilowatts:

7c per kw.-hr. for the first 15 kw.-hr. consumed, per meter per month.

3c per kw.-hr. for the next 85 kw.-hr. consumed per meter per month.

1c per kw.-hr. for all over 100 kw.-hr. consumed per meter per month.

Minimum charge: $2.00 per month per meter.

Part II

Where consumer's total connected load does not exceed 12.5 kilowatts:

7c per kw.-hr. for the first 25 kw.-hr. consumed per meter per month.

3c per kw.-hr. for the next 125 kw.-hr. consumed per meter per month.

1c per kw.-hr. for all over 150 kw.-hr. consumed per meter per month.

Minimum charge: $3.00 per month per meter.

Part III

Where consumer's total connected load exceeds 12.5 kilowatts:

7c per kw.-hr. for the first 3 kw.-hr. per month per kw. of connected load.

3c per kw.-hr. for the next 12 kw.-hr. per month per kw. of connected load.

1c per kw.-hr for all over 15 kw.-hr per month per kw. of connected load.

Minimum charge: $6.00 per month per meter.

The most apparent advantage which the above form of rate offers the central station is that it prevents the consumer—such as a dairy farm, for instance, purchasing a range and calling for the present forms of one-meter single-rate quotations to apply to his large lighting load and also the energy consumption of his many small motors, which under the power schedules would earn from 2c to 4c per kw.-hr., but under an amplified domestic service schedule would be granted a rate averaging possibly 1½c per kw.-hr. Further the above suggested rate-form is somewhat in line with the type of rate recommended by Mr. W. W. Briggs in a recent article published in the Electrical World, where the size of each lighting, cooking and heating block was automatically increased as the consumer adds to his total connected load by units as small as 2500 watts.

In the light of today's discussion, the above form of rate will seem a bit theoretical and possibly too scientific, but in my estimation it is the simplest form of rate which can possibly be developed to derive for the central station the monthly revenue which will be in direct proportion to the investment which the company must make and at the same time afford the small consumer a rate, the lighting and cooking blocks of which will not be so out of proportion to his actual kw.-hr. lighting and cooking requirements as to impose an undue burden upon the cost of his water-heating for which the tertiary blocks are designed. It is at once evident that unless some restriction is introduced into the rate in the form suggested, or, on the other hand, by lengthy and complicated definitions and tables of exceptions and limitations, it will be impossible for the central station to develop a revenue in direct proportion to each consumer's demand, for he will not be induced to install that type of water-heating and power apparatus which requires the installation of the least equipment on the part of the power company and also imposes upon the service company's lines the least instantaneous demand, the line disturbances from which can only be eliminated by the installation of high-cost copper and transformer equipment.

The adaptability of this simple form of rate brings us to Mr. Vincent's second question, which asks whether or not a form of amplified domestic service one-meter rate should include a lighting block, or, on the other hand, be developed only for cooking, water-heating and power and therefore necessitate the installation of a second meter to record solely the lighting consumption.

Before discussing the advisability of including the lighting block, I wish to bring to your attention a very important finding indicated in Mr. Vincent's chart for residence lighting, which you will find represents a study made from the consumption records of 3000 residence lighting consumers, and is developed to show not the theoretic mathematical average lighting consumption per consumer, but to show the number of kilowatt-hours which the greatest number of consumers average per month for lighting purposes. To be specific, we find that the mathematical average monthly consumption per domestic lighting consumer is 21.3 kilowatt-hours, which is obtained by dividing the actual gross monthly consumption by the 3000 consumers whose records were investigated.

For the development of the basic lighting block of an amplified domestic service schedule, our first thought would be to use this figure 21.3 kw.-hr. as the lighting block. A more careful study of the chart, however, discloses the fact that this figure is exceedingly misleading and is not applicable for use in the development of a combination rate, the first block of which might be intended to cover the lighting and appliance consumption for the average of the majority of domestic consumers.

Referring to the chart, we find that, of 3000 consumers, only 90 consumers used 21 kilowatt-hours per month. The peak of the curve, coming at 12 kw.-hr. per month, indicates that the greatest number of domestic consumers do not use more than 12 kw.-hr. per month for lighting purposes. Broadening this peak, to adapt it to a practical basis, we find that in the neighborhood of 12 per cent of the consumers use less than 8 kw.-hr per month, and approximately 63 per cent of the consumers do not consume more than 18 kw.-hr. per month. It therefore develops that 63 per cent minus 12 per cent, or approximately 51 per cent of the consumers, produce a monthly consumption for lighting and appliance purposes between 8 and 18 kw.-hr. per month. Or expressing this in a different manner, we might say that more than one-half of the total number of residence consumers use from 8 to 18 kw.-hr. per month, which gives us the practical or majority average monthly consumption of domestic consumers as $(8 + 18)/2$ or 13 kw.-hr. per month.

This figure, then, of 13 kw.-hr. per month, and not 21.3 kw.-hr per month, represents the number of kilowatt-hours which would most successfully adapt itself to use as the lighting and appliance block of a combination domestic service schedule. We find, however, that in the minds of those central stations developing one-meter rates to be applied generally to all classes of connected load, the lighting block is fixed at from 25 to 35 kw.-hr. per month, whereas the greatest number of consumers consume only 13 kw.-hr. per month. This point seems to me the most important factor in the development of a lighting block, and again indicates the necessity of making a small kilowatt-hour block rate for application to small connected loads and a second rate of similar form with larger kw.-hr. blocks for application to the lighting consumption developed by consumers having a larger connected load.

The average of the majority is not the average of the whole. But since our success with the majority is the measure of our success with the whole, the characteristics of the majority should ever be considered as our indices of the whole. If my logic is sound, then Mr. Vincent's third question, which asks what shall we make the top rate, is very simply answered; namely, 13 to 15 kw.-hr., at the prevailing lighting rates, for those domestic installations not exceeding say 7½ kw. total connected load. As noted above, I limit the first quotation of this proposed double-rate form to 7½ kw. because that figure will permit the installation of 1200 watts of lighting, a small range of 3500 to 5000 watts capacity, and the installation of 750 to 1500 watts automatic water-heating equipment.

The second top block can then be made 25 to 40 kw.-hr. at the lighting rate for application to all installations having an excess of 7½ kw. of connected load, the determining factor being the result of a study after the nature of Mr. Vincent's

chart, using data individual to the central station contemplating this form of rate.

The fourth question: "Are we justified in making a lower rate for cooking and water-heating service than for small power." The answer to this, forgetting for the moment the theory of "value of service," which, by the way, is receiving less and less consideration from our regulating bodies, is—we are not justified in making a lower rate for cooking and water-heating service than for small power, i.e., 3 to 5 kw. motors, unless we can specify the installation of such cooking and, particularly, water-heating equipment, the resultant load characteristics of which will earn from the central station a lower unit rate than is earned by the small power apparatus to which, heretofore, has seldom been granted a rate lower than 4c per kw.-hr. That is, if we are exploiting cooking or water-heating devices having 3 to 5 kw. instantaneous maximum demand, which requires the central station to make the same investment as is necessitated by the operation of a 3 to 5 kw. motor or other power device load, then the answer most certainly is that we are not justified in making a lower rate for any domestic device whose load characteristics impose the same service and investment requirements on the power company as small power apparatus, motors, rectifiers, etc.

I think I am borne out in my contention by the recent ruling of the Illinois Commission which, after hearing a defense given by an Illinois utility in an attempt to justify cooking and instantaneous water-heating rates on the ground of general increase in load factor, decided and ordered reconsideration of the company's formal power rates from the same standpoint, and pointed out to that utility, as I have just attempted to show, that the necessary investment to serve was the primary index in classification of load characteristics and resultant load factor, and not the nature of the service to which it was applied. Therefore, it is most necessary that each central station, during the period when it is formulating its cooking and water-heating rates, merchandising and sales policies, should consider the absolute necessity of exploiting to its prospective amplified domestic consumers only those cooking and, particularly, water-heating devices whose resultant load characteristics impose the minimum service demand and thereby require a minimum additional invesment in terms of the increased revenue which will result from the amplified domestic service.

The last question—how can we handle our water-heating —necessitates a double answer, because at the present time, although there is a decided trend in the direction of placing water-heating on a meter rate, a great number of companies are still exploiting water-heating by offering the consumer a flat monthly rate for a certain service.

A word with respect to the flat rate: Its application usually means the installation of a double-throw switch between range and water-heater, which makes it non-automatic in operation, and, together with all the difficulties incident to over-heating and under-heating, as your committee on water-heating points out, the most vital factor is that it imposes upon the housewife such added responsibilities of operation that the service is not worth the amount of money which the central station should earn from the exploitation of hot-water service. That is, from the standpoint of available revenue, the flat-rate does not, by virtue of the nature of the non-automatic apparatus which is usually exploited under it, give the valuable service which the consumer is willing to pay for if granted automatic equipment on a meter rate without the incumbrance of a double-throw switch.

From the standpoint of kilowatt-hour consumption, the flat rate induces no economy on the part of the consumer, and hence is economically wrong. The one undeniable advantage of the flat rate, however, lies in the fact that it offers a means of easy introduction, since the quotation of a flat rate, in terms of so many dollars per month, overcomes the high-cost-of-operation-fear inherent with the consumer at the mention of a continuously operated electrical device.

The second means of handling water-heating, namely, exploitation on a meter rate basis, induces maximum economy on the part of the consumer and is therefore the only economically-sound basis upon which electric water-heating can expect to find a permanent application.

The first point, however, in placing water-heating on a meter basis, is to accept the fact that, regardless of the type of apparatus or method of introduction, electric water-heating must be granted a low unit rate—1c to 1½c per kw.-hr., in order to make it economically practicable to the consumer in terms of competing fuel costs.

Immediately following this conclusion, in line with the points which I have tried to bring out, comes the conclusion that if electric water-heating, in order to be universally practical, must be granted a low unit rate per kw.-hr., then we must exploit that type of water-heating apparatus whose operation in terms of load characteristics and necessary station investment will earn for it, that is, entitle it to, the low unit rate of 1c to 1½c per kw.-hr. when compared to the load characteristics, etc., of other small power devices, motors, rectifiers, etc., the service demands of which, as has been pointed out before, do not earn the low rate required by electric water-heating. Hence the conclusion as to the method of handling water-heating would be—the exploitation of that type of water-heater so automatically controlled as to produce load characteristics which earn the low unit rate per kw.-hr. which will enable the meter application and the elimination of the flat rate, and at the same time earn for the company, by virtue of the value of the automatic service granted to the consumer, that revenue—$3.00 to $5.00 per month—which so many stations are now earning from water-heating consumption.

The last point to which I wish to ask your attention is the advisability of developing a rate of such form, or including a provision, to make practicable the operation of low-capacity automatic water-heaters even if an electric range has not been sold.

You will note that the first rate in the above-suggested form will enable the economic operation of an automatic water heater installed in connection with only the lighting requirements, which total connected load would not exceed 7½ kw. In my experience, the water-heater offering automatic hot-water service has always proven an effective salesman for the range. Everyone knows what hot water is, and further, appreciates the value of automatic hot-water service. No missionary work is required in introducing the automatic water-heater which can be operated on an economical basis, whereas electric cooking, being less tangible as between salesman and consumer, many times defers the sale of both the range and water-heater.

Given the ability to introduce electric cooking through the medium of automatic hot-water service, and given water-heating apparatus which is so automatically controlled that it requires no additional transformer, copper and meter investment, and finally, given a rate with the high cooking block eliminated until the range is sold, the condition is then ideal for the production of maximum revenue from the minimum investment and the least sales effort and expense.

The power man may assist the farmer in production of agricultural products by joining in the "swat-the-rat" campaign. Some idea of the expense connected with the maintenance of rats may be learned from the fact that a full grown rat consumes about two ounces of grain daily, from forty-five to fifty pounds a year. At the present price of wheat, it would cost a warehouse man several dollars annually for the maintenance of each rat upon his premises. Since other food supplies are now proportionately high, the expense of rat maintenance to the average householder may be just as great.

ELECTRIC COOKING AND WATER HEATING

(Electric cooking and water heating are subjects of tremendous import in the West where available hydroelectric energies are daily extending the application of electricity to every detail of the modern home in the West. Here is a discussion participated in by practically every well-known man of the electrical industry in the West interested in this phase of electrical development. The following pages are the stenographic reports of the discussion on this important subject in the commercial section of the Pacific Coast Section N.E.L.A. convention at Riverside, April 19-21, 1917.—The Editor.)

S. V. Walton: We have two more subjects on our program for this afternoon, and we will now have to stop the discussion on rates. The next subject is electric cooking and water heating. In the absence of Mr. Black of the Great Western Power Company who was delegated to handle this subject and who abstracted the report, I will refer to the printed report in the Journal of Electrcity of April 15th and April 1st which contain the report of the water-heating committee, giving results of laboratory tests. In justice to the Northwest Electric Light & Power Association I want to say that the water-heating report was started by the Northwest Association a little over two years ago. The tests were made in a laboratory of our company, supplemented by other tests, some by the Great Western Power Company, particularly, and, as far as I know, constitute the first and best authentic records of such tests. The cooking and water-heating subjects go together. Electric cooking by itself is incomplete. Our records show, and I think the records of any other company that has taken the trouble to get records will show, that the water heating load in addition to the range load more than doubles the business without increasing the demand on the central station, providing proper equipment is installed. Our records show on a large number of installations that the return per month per consumer of ranges alone was about 103 kilowatt hours. For water heating alone it was about the same. That the two together would more than double the two added together and treated separately, for the reason that where the water heater is installed with the range it makes a complete electric kitchen, and the use of the equipment is carried out more than where only one is installed and other apparatus, either coal, wood or gas, left in the kitchen to fall back on. The subject of rates is intimately tied up with the subject of cooking and particularly water-heating. I question whether we can get very far on the water-heating subject unless lower rates are made, either flat rates or very low meter rates.

I think it better to have a full discussion on those various questions from the floor rather than too much from the chairman. You all have the report to read. Is Mr. Childs, of the Southern California Edison Company, in the room?

A. W. Childs: The question of electric cooking and water heating has been interesting the companies of Southern California for the past year, and our company is maintaining an organization especially for the promotion of the use of electrical energy for these purposes. We have found it advisable to adopt a rate by schedule which the householder can take the energy for lighting, cooking and water heating through one meter. We have started with an initial rate of 7 cents, our regular lighting rate, divided the dwellings into three classes according to the number of rooms, houses of five rooms or less taking the first twenty kilowatt hours per month at the 7-cent rate, six or seven room dwellings the first thirty kilowatt hours, and residences having in excess of eight rooms the first forty kilowatt hours at 7 cents. For the next 100 kilowatt hours where an electric range is installed and used, a rate of 3½ cents per kilowatt hour is given and if a water heater is installed, after the block of 100 kilowatt hours at 3½ cents a rate of 2 cents is applied. We have at the present time installed or contracted to install 1450 ranges. We started the range promotion sometime prior to the promotion of the electric water heater, but the electric water heater is taking very favorably. We now have in the neighborhood of 100 installed and in satisfactory operation. The range as it is manufactured and sold today we find to be quite a satisfactory product. It is filling the bill. The water heater has been brought forward very rapidly and it also is filling the bill. We find quite a sale for the automatic water heater which allows hot water to be on tap during the 24 hours, and quite a demand also for the non-automatic water heater, both of the boiler type. I don't know just what phase of this subject to emphasize in starting the discussion. The load is attractive. The want is apparent, and is felt especially amongst the rural consumers. We believe that the elertric cooking and water heating load offers one of the best opportunities before the central station today.

Chairman: There is one phase of the subject that I meant to touch on but did not think of it until Mr. Childs mentioned the word "felt." It seems to me the problem in the water-heating game, in addition to the rate, is one of insulation I am going to ask Mr. Newbert of the Pacfic Gas & Electric Company to discuss the subject.

L. H. Newbert: In discussing this matter I will only tell you in a brief way of our work. We believe that it is a subject that we have yet to learn a great deal about. Therefore we are proceeding rather conservatively. What we are doing we are endeavoring to do well. By that I mean we are not endeavoring to place the greatest possible number of electric ranges and water heaters, but we are endeavoring to sell the ones that we do sell in a manner that will result in their staying on the line. A failure in a small place is generally known by all in the community and the injury done is hard to undo.

We are limiting the work almost wholly to what we call our suburban territory. We have a small organization consisting of a chief salesman, a head demonstrator, and several salesman. We hold demonstrations in the different centers of population. These last from two to three, four or five days, depending on the size of the place. These demonstrations are advertised as electric cooking schools. The prospects developed at these schools are followed up by salesmen. We confine our attention to people or consumers who we believe can afford to use the electric range, because we don't claim that electricity is the most economical of fuels. We believe that it has advantages which justify paying a little higher price for the service. We endeavor to displace entirely other means of cooking, and aim to secure complete electric kitchens.

While our number of installations is rather small, we have a very high percentage of water heaters. Our range connections last year were 335, and of that number 165 had water heaters installed. That means that we have about 165 all-electric kitchens.

Our company is selling ranges at manufacturer's list price, allowing 10 per cent down and the balance in 12 equal monthly installments. The cost of installation up to $50 is borne by the company. Any amount over $50 is charged to the consumer.

The work of installing is let out to local electrical contractors. Ths has worked out generally satisfactorily. Not always, however, because in some districts we have had difficulty in getting a contractor to do the work promptly, and when it is not done promptly dissatisfaction results. In other words, the consumer is disappointed and dissatisfaction follows.

After the range is installed the demonstrator calls and gives very thorough instructions. The call is followed up by as many future visits as may be necessary in order to thoroughly instruct the operator.

We have found that where hired help is in the kitchen we have our difficulties. On the other hand, even at our rate, which all our consumers think high, we have found the operating cost reasonable where the work is done by the housewife.

The average bills for range and water heater consumers last year was $6.85. The water heater alone, $3.85. The range alone, $3.65. Where we are able to place a water heater with the range we just about double our revenue without any additional investment. All our installations are made with a double-throw switch. In other words, the water heater is not in service and cannot be used when the range is in service. Therefore when we are able to place a water heater we double our revenue without any additional expense whatever.

We do not confine our sales to any one make of ranges. We sell all that we think will give satisfactory service, so as to distribute our business amongst the various jobbers. The ranges all give satisfactory results. We, of course, have some difficulty with elements burning out. However, in this respect we have the heartiest co-operation from the manufacturers and jobbers and, I think, our consumers are generally satisfied with the service that we are giving in maintaining the ranges.

There is no question but what the electric range has a big future. Anyone who sits back and pooh-poohs that idea will find out that he is mistaken. The water heater problem has not yet, of course, been solved, and I believe will be solved only by making special low rates on small heaters operated over rather long periods, rather than heaters of large capacity, operating for short periods.

Chairman: Mr. Newbert, Mr. Whaley wants to ask you what rate you find will produce a satisfactory monthly revenue?

L. H. Newbert: Our schedule is as follows:

Schedule No. 152.—Electric Cooking, Heating and Power Rate

Based on the monthly consumption per meter

4\. cents per kilowatt-hour for the first 30 kilowatt-hours per kilowatt of active connected load.
2\. cents per kilowatt-hour for the next 90 kilowatt-hours per kilowatt of active connected load.
1.5 cents per kilowatt hour for all over 120 kilowatt-hours per kilowatt of active connected load.

Minimum Charge

Contract.—Where consumer signs a contract agreeing to take service for at least 12 consecutive months the minimum charge will be $24.00 for each 12 months' period for the first 5 kilowatts or less of active connected load, and $12.00 per kilowatt for each kilowatt of active connected load in excess of 5 kilowatts. Minimum due and payable monthly.

Non-Contract.—Where consumer does not sign a contract for at least 12 consecutive months the minimum charge will be $2.00 per month for the first 5 kilowatts or less of the active connected load and $1.00 per kilowatt for each kilowatt of active connected load in excess of 5 kilowatts.

Active Connected Load

The active connected cooking, heating and power load shall be taken as 100 per cent of the first 2 kilowatts installed and 50 per cent of the connected load installed in excess of 2 kilowatts, computed to the nearest one-tenth of a kilowatt, but is never to be taken as less than 2 kilowatts. Motors and instantaneous water heaters will be rated as 100 per cent active connected load. Motors aggregating not more than 5 horsepower, and not in excess of the total connected load of heating and cooking appliances, may be included on this rate and will be rated at 1 kilowatt for each horsepower of output rating. Where the connected load is so arranged that all of it cannot be connected at one time, only the maximum load that can be connected will be used as a basis for the active load. All equipment will be assumed as operating at 100 per cent power factor.

Installation

The consumer's wiring for electric cooking, heating and power service must be separate and distinct from that supplying other service, and no lighting installation will be permitted under this service, except indicating or pilot lights used in connection with heating and cooking appliances.

A suitable meter board must be provided with service switch and cutouts. The cutouts or fuse blocks must be installed in a metal box, which may be sealed by the company, the cutout box to be located ahead of the meter.

When the active connected load does not exceed 2 kilowatts, service will be supplied at 2-wire 110-volts. When the active connected load is in excess of 2 kilowatts, service will be supplied at 3-wire 220-volts or 2-wire 220-volts. When 3-wire 220-volts service is supplied the consumer's circuits must be connected on each side of the neutral conductor so that the actual unbalance of the load on the 3-wire system should at no time exceed 1800 watts.

When motors are used under this schedule the service conditions for same must conform with the rules for power service.

Territory

This rate applies in all territory except in the cities of San Francisco and Sacramento.

E. B. Criddle: What average rate per kilowatt hour does that make for the consumer?

L. H. Newbert: About .029 per kw.-hr.

A. G. Wishon: What load factor?

L. H. Newbert: We have really as yet no reliable information on that point. We are now preparing to get the information, and also the diversity factor, so far as we can, with the limited number of installations we have. The information will be available within the next three months.

H. S. Batchelder: I would like to ask Mr. Newbert and Mr. Kennedy what provisions they are making to make the combination perfect electric kitchen. We cannot call a kitchen electrically equipped which in our climate is not equipped at certain times of the year to take care of the heating question. A kitchen which has an auxiliary burner, either for the disposition of garbage or a gas or coal oil stove, is not an electric kitchen. I would like to ask those gentlemen what method they are pursuing toward making the kitchen an electric kitchen throughout under those conditions.

L. H. Newbert: From that viewpoint we have no complete electric kitchen, because we have made no attempt to heat the kitchen with electricity. We have many consumers who do not require heat in the kitchen. They have heat in the dining room which is communicated to the kitchen. Where the consumer does want heat in the kitchen we have recommended an inexpensive type of air-tight stove which can be purchased for four or five dollars.

H. S. Batchelder: Why is that done? Are we not trying to establish a diversity factor which will take care of the current we have to sell? Isn't there some method that can be devised whereby the heating can be maintained electrically in the kitchen instead of pursuing roundabout methods to avoid the question?

L. H. Newbert: I cannot answer the last part of your question. At our rates at the present time we do not believe it would be fair to recommend to the consumer the heating of their kitchens with electricity.

Chairman: I have discussed that very question with Mr. Coldwell of the Northwest Association. They have a condition of more extreme cold than we have, and some of the companies, particularly at Spokane, have given a great deal of thought to that problem.

O. B. Coldwell: I cannot say that that problem has been solved in Spokane any more than here. The question of air heating in large cubical contents is something that possibly we are hardly up to as yet. In that connection I have in mind a pamphlet which was put out by the Oregon Hydroelectric Commission only recently going into the relative heating values of the various kinds of fuels used in household heating, and there are some very startling figures given. I cannot recall them at the moment except in one or two cases where with wood at something like $5 a cord and electricity at one-half a cent a kilowatt hour, you have a disparity of something like ten to one in the matter of cost. In other words, it is discouraging to find that solution just at the present moment. Personally it seems to me that the investment factor that is involved in carrying out general house heating would be almost prohibitive at the present time. But that is getting off on the point you are making which is merely that of the kitchen in the case of Spokane which was mentioned by Mr. Walton. I believe they have solved it as some of the member companies here have by means of the briquet heater or small gas heater or combined refuse burner. I cannot assure you that we have solved the question in the Northwest any more than you have here.

H. S. Batchelder: What I would like to know is this: There are certainly on the market electric heaters of sufficient capacity to heat an ordinary kitchen. Why not sell them? We have the electricity to run them and they can

be run economically provided the conditions are right. You admit that the majority of the business is obtained in suburban districts. Under those conditions in these districts, owing to the H. C. L., wood, coal, and gasoline have gone up, and it seems to me that we could compete with those articles. Have you, Mr. Newbert, or have your salesmen asked out in the suburban districts how much their average monthly fuel bill was, and received a reply that was approximately correct?

Chairman: I would like to ask you the same question.

H. S. Batchelder: There is a thing I wanted somebody with some experience to tell me. Why can't we sell an electric kitchen complete? I have an idea for a solution. In the past 55 days we have placed 19 electric ranges, 15 water heaters and 11 air heaters. There were no air heaters sold in the past two weeks because we had warm weather. We find in every instance where we sell a range that we can sell a water heater where it is properly introduced. The only reason we have not sold those four was on account of the erection of new houses. In those instances I have found that in most cases they knew fairly well what they were burning, because they have carted the wood and the coal and the coal oil to their ranches, and I have made them approximate what that cost was per annum, and on our rate have shown them what it was for heating it electrically. That is, I have taken a certain type of radiant heater, and by experimenting myself and with a few of the consumers, we have found that we can heat the average kitchen in comparison with an ordinary stove or auxiliary heater as cheaply on a 1½ cent rate as they could with any other method. I don't mean to keep an electric kitchen heater averaging 1800 watts going ten hours a day, but heating it comfortably by operating a doublethrow- switch, said heater having 3 switches, 1, 2 and 3 heats.

S. M. Kennedy: The question, Why not an electric kitchen, is a very pertinent one and it is not at all an impossible condition. Mr. Coldwell who comes from a cold country, and some of the other Northern people who do not live in the glorious climate of Southern California, have different conditions from what we have. In the south we believe we are about to solve the question, and when the consumer wants electricity in the kitchen he can have it for everything. We believe that with the cooking rate at 3 cents a kw. hr. for the first 100 kw.-hrs. after taking an average amount for the lighting requirements and the balance at 2 cents, that we have to a large extent got the water heating question solved, and we have also the question of taking care of the heating of a kitchen in the winter time. We have filed a schedule of the character that I have spoken of that is very easy to understand. When the range is on the water heater is off. Consequently, if that schedule were effectual, the room heater would be off at the same time.

But we propose to mutilate that schedule. We are going to make it so that they can use the range and the water heater at the same time, and if they want to use a room heater they can do it also. Now, why have we changed? We find this idea of the water heater piling up your peak is a bugaboo. It doesn't do it. Consequently, you can leave the water heater on at the same time and eliminate the double-throw switch, and this helps to build up your cooking load. The average kitchen is not a big room, and in the winter time in this glorious climate of Southern California, the amount of heat required is not a great deal.

Why talk of any other means than electricity for heating? We have the electricity to sell. We have the installations. We have the transformers and the meters. For goodness sake, why do they want to bring in anything else to heat the kitchen, especially in Southern California?

Let me point to another phase. Mr. Coldwell has spoken of wood at $5 being about equivalent to electric heat at one-half cent per kilowatt. How much of that wood heat goes up the chimney? How much of the heat efficiency is there that you do not get in the kitchen? How much of the electricity do you use when you put it into some kind of a heater? You get 100 per cent efficiency. If you are going to look at the heat units in wood or coal or any other fuel and compare them with heat units in the kilowatt hour that stays in the room in a good clean way, there is no chance of doing business. But if you give the electricity the credit that is due to it and you put it on at a rate as low as 2 cents per kilowatt hour after you have supplied the lighting and the cooking, you are going to get the electrical kitchen which we all want.

John A. Britton: Any gentleman here who desires to be educated thoroughly and fully upon the question of the efficiency of British thermal units, let him attend the gas association's convention to be held in Northern California in September.

H. F. Jackson: I would like to say a word. I have had just the experience Mr. Batchelder referred to. We decided a year ago that this idea of double meters, double throw-switches and four or five other things, was a big bugaboo. We have had experimental rates in effect about a year. Anything in a domestic installation we put on the one meter. The first 25 kilowatt-hours at 10 cents, the next 100 at 3 cents, and all over that for any purpose, 1.1 cent, with 10 per cent discount for prompt payment. We think it is solving the question. We don't think we are suffering. As I say, it is an experimental rate, and in the meantime we are popularizing the house electrical and we have several consumers in the San Joaquin Valley who are enthusiastic over this rate. I am talking for one meter, one service, and a block rate that will take care of the different kinds of use.

Chairman: Mr. Britton calls my attention to the fact that Capt. Jackson is not an electric light man but a philanthropist.

Glenn D. Smith: I would like to talk more particularly to the managers of the small companies on the matter of electric cooking. Being the manager of a small company (Ontario Power Company), it is possible that you will be interested in our experience along this line.

We started last June with demonstrations in the two principal cities where we operate, Ontario and Upland. We ran demonstrations in these two cities simultaneously for thirty days, demonstrating the ranges, serving people with lunches, and carrying on a campaign of advertising and education.

After closing the demonstrations, we put out solicitors and also established an electric kitchen in our office building and created a range service department in charge of a young lady demonstrator. This young lady not only has charge of the range sales at the office, but gives demonstrations in our electric kitchen and also makes voluntary calls upon the users of our ranges to assist them in any way she can and particularly in working out the proper economy. Since last June we have installed approximately 140 ranges, being about one to every 17 of our residence customers.

Prior to our demonstration, we had 123 customers who were cooking with the separate ovens and the old-time individual stoves. Some of these have changed over to ranges. We have now about 250 who are cooking exclusively with our current. Our rate is for the first 20 kw.-hr. per month, 9c, the next 130, 3c, and all over that, 2c, with a 10 per cent discount for prompt payment. We have had very little complaint. The users of the ranges are pleased with them and are using them economically. I recently took a list including the first 92 of our cooking accounts and the average bill was $5.08 and the average consumption, 140 kw.-hr. per month.

We permit on our cooking rate, the use of current for any domestic service. They can charge their electric automobiles, grind chicken feed, or use the current for any purpose they wish; however, very few use it for any purpose except cooking, heating and lighting.

As to heating the kitchen, many of our people are heating their kitchens electrically. The current used for this purpose

would come on the 2c rate, and those who are using it seem well pleased with the service and the cost. We are heating one house exclusively with electric heaters. We installed the heaters in this house more as an experiment than anything else. They have been using it practically all winter and consider it the most satisfactory heating they have ever had, it being flexible, clean and convenient, and the experiment with this house seems to indicate that a rate of about 1.2c per kw.-hr. would compete with coal.

The average small company has but small opportunity to increase its industrial power load and I believe the residence field is the one that should be strongly developed and I believe that the electric range offers the opportunity for this development and that any small company that will take it up and not be afraid of it and will push it, can do as well as the Ontario Power Co. I have analyzed very closely the past three years the returns from business on our cooking rate and I find, and I think I can defend this, that one cooking customer is as good as five lighting customers in the annual net returns of the company. You may not be able to make the same rates as we have as that would depend upon your generating and distributing costs, but, I believe that the small company has to look to the electric cooking for its largest increase in business and that it is their most promising field.

Chairman: I have to hand it to these Southern California fellows for the way they hang together on the climate business. Will you come forward, Mr. Kimball of Oakland? We want to look you over.

Hugh W. Kimball: I would like to say a word on the subject from the standpoint of a contractor-dealer. Mr. Jackson made a point pertaining to the selling of electric current both for light and power on one meter, having a minimum first charge at the regular rate current is sold for lighting purposes covering the maximum consumption of current used in the average home for such purposes, and then resorting to the power rate as determined by the various companies for the balance of the load. This point has appealed to me from a standpoint that has not been touched on, and that is, the economical simplicity of installation. You must realize that it would be much easier for the power companies and for the consumer and for the electrical contractor and all concerned to make it possible to consume this current under one meter reading than under two.

In the first place, the expense of wiring installation would be materially decreased. The Underwriters' rules must be conformed with and it often occurs, in preparing a house for an additional meter, that we have to install an entire new service due to the rules pertaining to the installation of two meters, whereas in reality the present feeds are adequate as far as manner of installation and current consumption is concerned. Furthermore buildings already constructed have been prepared for a meter space or box of sufficient size for one meter and the electrical contractor often finds it necessary to tear this box out, cut a larger opening in the building which must be finished in workmanlike manner and a new cabinet installed of adequate size to allow two meters and the necessary additional cutouts, switches, etc., for same. This, of course, is of considerable expense to the owner, very often to such an extent that it is prohibitive. The idea of installation of heating devices is often abandoned on this account.

Secondly, the furnishing of current for both purposes under one meter instead of two would save the expense of one meter on each installation for the power company.

In the third place we have found that a big obstacle in the way of placing electrical heating devices in the home is, that in making the installation with a varied rate on two meters we have to explain to the consumer, and it is hard to explain to them because they do not understand all the intricate details pertaining to the installation and the expense thereof, and they very often become confused and give up the idea for the simple reason that they do not understand it. The public take a great deal on faith as it is but it is next to impossible to get a man to part with his money when he does not understand just what he is getting in exchange, and what the ultimate outcome of the whole transaction might be.

If the power company could sell this current to the consumer under one meter reading for both purposes these obstacles could be reduced to the minimum.

Another point that has not been touched on to a great extent is, the proper education of the public of the use of electrical heating and cooking devices. I listened to Mr. Batchelder's remarks in regard to the placing of air heaters in the kitchens where electric ranges are used, for the purpose of warming the room and his question as to their practicability. My firm put on the market last year, as they have for several years, a large quantity of air heaters, varying in size from 500 to 1800 watts. Most of these have gone to the consumers who were paying for their current on the seven cent rate. In selling the heaters we have been careful to explain to the consumers just how long they could burn the heater for their seven cents, or just what they were paying for an hour's consumption. I am positive from records that have been kept in my place of business that out of approximately 150 which were sold during the last winter season we only had one complaint from the stand-point of the consumption of current and practically no complaints from other reasons. Now, if we can install these heaters on a cheaper rate in conjunction with electric ranges, water heaters, and other current consuming devices, or on the same meter measuring the lighting consumption load on a varied rate as previously explained, I am positive there would be no complaint of any nature, and that we could place a far greater number of heating devices in the homes.

The education of the public to the proper use of heaters also holds true in regard to the sale of electric ranges. I know of one installation in the northern part of California where a large apartment house was equipped by the owner for the use of electric ranges. That seems to me to be a thing that all electrical men should discourage for this reason; that if consumers do not know how to handle the range and what the range will do, it is not going to be economical. I talked to the owner of this building and he told me that he was forced to remove the electric ranges in this apartment house, due to the fact that they were not satisfactory from a current consumption standpoint. The electric range was a big drawing card in obtaining new tenants; the young housewife going into the apartment would, of course, start using this range when she would not have any knowledge whatsoever of the consumption of current and its use, nor the proper method of obtaining the highest efficiency from the current consumed, with the result that half of his house was without tenants most of the time, due to the fact that after the first month's bill arrived for current the tenants were discouraged by the enormous cost and could not be persuaded to continue. A thing of this kind is extremely detrimental to the perfection of the sale campaign we are putting on to carry this product to the market. I believe the power company should instruct their solicitors to be cautious in making claims to the public of the current consumed by various devices and particularly in the instruction to the public of the proper use of such devices.

I have in mind a case where we installed a certain type of range in conjunction with a water heater and an air heater for one housewife, who found it very satisfactory and economical. We made an identical installation for another consumer, with the exception that we furnished an additional oven. I was not anxious to make this sale for the reason that she had a colored cook in her kitchen and I found she paid little attention to household matters. The latter installation eventually proved unsatisfactory to the purchaser and naturally was not of any credit to the industry. The first

installation was handled at an average of from $5 to $6 per month, while the latter averaged to from $30 to $40. The colored cook used this range at all times and I think he tried to heat the kitchen with the range which, of course, was impossible. That is ultimately going to hurt all the way down the line, as will every unsatisfactory installation. The news of a poor installation will travel a great deal more rapidly and take deeper root with those who bear it, than woud a half dozen satisfactory installations.

There are many ways in which the electrical contractor and dealer can co-operate with the central station men in the proper placing of this product on the market. There is one point I might touch on in closing; and that is the manner of installation. In our district we have paid particular attention to the installation of ranges and the necessary wiring and equipment for same. It has only been a short time since we had a committee of the inspection force of the city hall at our store for the purpose of going over the proper manner of wiring for and installing electric ranges, with a view of lessening the cost of the installation to the consumer. The rules of the Underwriters pertaining to the installation of electric ranges is that portion of the rule pertaining to the installation for power equipment and in many instances is far more drastic and expensive than is necessary for the installation of ranges. If the central station companies throughcut the State will work in harmony and in conjunction with the electrical contractors and dealers in obtaining from the various inspection departments, special rules pertaining to the installation of ranges the expense pertaining thereto each could be greatly minimized which will greatly assist in bringing their product and our product to the market.

Chairman: We are very glad to have had Mr. Kimball speak on this subject. I don't know of any one in the dealer and contractor class, as we know them in the vicinity where I come from, who is better qualified to speak on the subject than Mr. Kimball, both from the dealer and from the contractor point of view.

W. S. Leffler: Mr. Black has properly said in his paper on electric water heating that, although there seems a decided trend in favor of the step-thermally controlled automatic water-heater, yet the field of hot-water-service exploitation is still characterized by a wide divergence of opinion..

I wish to discuss revenues, comparative net revenues, comparative sales effort, and comparative value of the service rendered the consumer by the different types. Or, in other words, how much is the best kind of hot-water service worth to the consumer, and what will the net revenue to the central station be, when fixed charges on the station's investment (equipment and sales cost) are deducted from the gross revenue available from that type of apparatus which renders the most valuable service to the consumer.

As our specific examples, let us take, on the one hand, the 5 kw. instantaneous-demand non-automatic, manually-operated, circulation type of tank heater, and our second example—directly opposite in every characteristic—the 1.5 kw.—250 watt graduated-step-demand, automatic, thermally-controlled immersion storage heater.

First, let us consider the water-heater as isolated from the range, both from a revenue and investment-to-serve standpoint. That is, altho it has been shown that the water-heater, properly handled, doubles or triples the range revenue without increasing the investment, the point I wish to make is that we cannot charge all the domestic service investment onto the range after the water-heater is installed, but instead should charge against the water-heater its pro rata of the total investment made to serve the combined range and water-heater.

Returning, then to the two widely different types of heaters, and taking first the 5 kw. instantaneous, non-automatic, circulation equipment:

Consider first the value of the service rendered. It is at once evident that the non-automatic type of heater is hardly more than a poor substitute for a non-automatic coil gas heater. It is not much more trouble to strike a match than it is to turn a switch, and further, since the average 25 ft. coil gas heater has about twice the speed of a 5 kw. circulation electric heater, it is at once apparent that, in exploiting this type of equipment, we are merely offering the consumer a service which, with all factors considered, is at best little better than a poor emulation of the small non-automatic gas-heater service. Since the small gas heater gives this service for about $2.00 per month, it is economically unsound to think that this same service electrically rendered would bring more than $2.50 per month, for, as Mr. Britton has just said, the consumer's mind is found to travel back to gas service.

As to actual kw.-hr. consumption, it is further evident that, due to the necessary wait of 15 minutes or so to secure water in practical amounts, the consumer would use much less hot water and hence we would expect the high capacity non-automatic type of heater to reduce our available water-heating revenue by from 75 to 100 kw.-hr. per month, which therefore almost automatically limits the revenue, with energy at 1c to 1½c per kw.-hr., to about $2.50 per month, or approximately $30.00 per year—gross revenue from 5 kw. instantaneous demand. Now if our domestic feeder, transformer and pole-to-house investment aggregates even a minimum of $20.00 per kw. of domestic load connected (forgetting for the moment the possible necessity of hanging a special transformer for the installation), then for a 5 kw. heater we have a fixed feeder investment of $100.00, with annual interest, maintenance and depreciation charges of 15 per cent, amounting to $15.00 per annum, which when deducted from the gross available revenue from this type of apparatus, namely, $30.00, leaves only $15.00 net annual revenue from 5 kw. of demand, or $3.00 per kw. per annum, together with the fact that, since we are merely emulating non-automatic gas service, we cannot possibly expect to derive a larger revenue than that above indicated.

Turning now to the consideration of the heater of opposite characteristics, namely, the step thermally-controlled type of heater referred to in the report of your committee, we have:

First, with respect to the value of the service. Instead of non-automatic, intermittent electrified gas-service, we are now able to offer the consumer automatic instantaneous, continuous hot-water service available to every tap in his house, at the scalding-point temperature (far above gas temperatures if he so desires it). Hot water in any quantity to suit his needs, whether he have a two-room bungalow or a 200-room hotel. Perfect service—automatic service—no repairs, and the complete elimination of all flame and gases and the menace incidental to operation of a fuel heater. As to the value of the service, most certainly this service is worth the dollar or so more than the $2.50 per month at which we have just been evaluating the non-automatic, intermittent, gas-emulated service.

The experience of a half-dozen coast companies show that this automatic service, by virtue of its value, really sells for from $4.00 to $6.00—which the 200 to 400 kw.-hr. per month consumption earns under the prevailing Coast rates. So, as to the value of the service. Even figured against the automatic gas-heater bills, the service, including the frequent repairs and gas copper coil replacements, is well worth $60.00 per year. Properly applied sales intelligence will readily sell this service for $50.00, which this type of water-heater will earn at 1½c per kw.-hr.—or $40.00 per year gross at 1c per kw.-hr.; $40.00 per year minimum gross revenue, because the automatic service is worth $40.00—assuming, of course, as Mr. Kennedy has just said, we are using that type of apparatus which obviates all necessity of the double-throw switch due to the automatic action of the step thermal control developing such load characteristics as keep the water-heating load

(Concluded on page 449)

PACIFIC COAST SECTION N. E. L. A. JOTTINGS

(Activities of the Pacific Coast Section, N. E. L. A., during the past semi-monthly period, have largely been in the nature of outlining suggestions to the state and federal authorities concerning definite service that central stations of the West are prepared to render to the national government during the present crisis. Other undertakings of this organization, of interest to engineers of the West, are reflected in the minutes of the executive committee meeting of May 25, 1917, details of which are set forth in the following lines.—The Editor.)

MINUTES OF EXECUTIVE COMMITTEE MEETING MAY 25, 1917

The meeting of the executive committee of the Pacific Coast Section National Electric Light Associa-was called to order at 10:15 at the office of the president, No. 58 Sutter street, San Francisco, May 25, 1917.

Present: President Jackson, Vice-president Samuel Kahn, Secretary A. H. Halloran, Henry Bostwick, W. W. Briggs, D. E. Harris, H. C. Reid, K. E. Van Kuran.

President Jackson announced the appointment of S. V. Walton as chairman of the commercial committee, J. E. Woodbridge as chairman of the Engineering Committee, C. P. Staal as chairman of the Accounting Committee, and W. L. Frost as chairman of the Membership Committee. The chairman of the several committees will decide upon the personnel at a later date. He also outlined Mr. Van Kuran's suggestion that sub-committees be appointed at Los Angeles, Reno, Phoenix and Albuquerque to make suggestions to the general committees, through their local representative on said committee.

John A. Britton of San Francisco, W. A. Brackenridge of Los Angeles, A. G. Wishon of Fresno, George Campbell of Reno, M. R. Buchanan of Silver City and Frank Russell of Tucson were selected as members of the Public Policy Committee.

President Jackson announced that the Committee on Petroleum of the State Council of Defense had requested the association to offer suggestions as to how a further saving could be made in the use of fuel oil. He told of a meeting with Mr. Max Thelen, chairman of the committee, in which he had outlined four suggestions which upon receipt of further data from member companies will be incorporated as a part of the committee's report to the council. These suggestions include (1) the inter-connection of all transmission lines so that any deficit of hydroelectric power on one system may be purchased from another system having a surplus without the necessity of starting up steam reserve plants; (2) that representations be made at Washington to induce the government to change its policy regarding the development of public lands so that more hydroelectric power may be available; (3) that the railroads be electrified so as to reduce the consumption of fuel oil in locomotives; and (4) that some definite policy of extensions be adopted so that electric motors may be substituted for gas engines and isolated plant service with some scheme of protection from the Railroad Commission to provide against taking of unprofitable business.

K. E. Van Kuran stated that the proposed taking over of distribution lines at Los Angeles by the city would complicate the plans for joint merchandising action between the central stations and contractor-dealers. He was finally advised to take up the matter individually with the Los Angeles interests concerned.

Henry Bostwick introduced the following resolution to be sent to the several state councils for defense represented in this section:

"Resolved, That the Pacific Coast Section of the National Electric Light Association, through its secretary, address the secretary of the State Council of Defense, tendering to the council the active support of the section as well as of the individual members of the association.

"This association having associated with it practically all the electric power companies of the state, it is felt that such co-operation can be of great value to the council in the matter in hand."

On motion duly made and seconded this was adopted.

The appointment of S. J. Lisberger as representative of the section on the committee for the revision of the San Francisco Electrical Ordinance was approved.

Meeting of the Commercial Section Committee

A meeting of the commercial section was called by Chairman S. V. Walton at San Francisco on May 25th, with J. B. Black, H. A. Lemmon, A. E. Holloway, R. M. Alvord, Miles F. Steel, W. S. Berry and M. L. Scobey of the committee present, and E. B. Walthal, H. C. Aller, C M Einhart, A. W. Childs and E. B. Criddle absent. The meeting was also attended by G. F. Wakeman, Frank Somers, Jas. W. Redpath, Ed. Whaley, L. H. Newbert and C. F. Butte.

It was decided that sub-committees be appointed by the general committee member in each locality to represent the various electrical interests so that their recommendations may receive action by the general committee. The following schedule of work was outlined as the year's program.

(1) Study of merchandising conditions arranging for co-operative selling plans between central station and contractor-dealers on lamps, ranges, appliances and motors.

(2) An investigation on electric cooking and water heating.

(3) Study of industrial electric heating.

(4) Report on illumination, outside and inside.

(5) Investigation of electrical vehicle situation.

(6) Report on refrigeration.

These several subjects handled by sub-committees and will form the basis of reports to be presented at the convention.

It was decided there should be four meetings of the Commercial Committee during the year to be supplemented by frequent meetings of local sub-committees.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(The starting of motors by what is known as the "star-delta" method is a matter of much importance to the contractor and dealer. This article completes the discussion on this subject which was begun in the issue of February 1, 1917. The explanation of the methods of selecting fuses for motors stated in this manner is exceptionally complete and is shown in an original way. It should serve to clear up much misunderstanding on this subject. The author is power apparatus specialist for a well-known electrical supply house in San Francisco.—The Editor.)

STAR-DELTA METHOD OF STARTING THREE-PHASE MOTORS

In the original installment of this article which appeared in the February issue of the Journal the scheme of controlling motors arranged for this method of starting by means of an ordinary three-pole double-throw knife switch was discussed. A diagram showing the connections between motor, switch, fuses and line was included. The statement was made that by slightly modifying the connections, standard motor-starting switches could be used for this purpose.

Fig. 1 shows the connections of an enclosed switch of this type just recently placed upon the market. By comparison with the diagram given in the first article

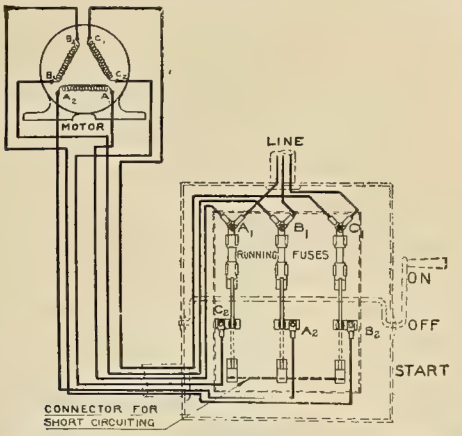


Fig. 1. Wiring Diagram for "Square D" Motor Starter, Star-Delta Type

it will be noted that the connections are identical except that the fuses form a part of the switch instead of being mounted separately. This switch is equipped with a spring-operated steel latch inside the cabinet so interlocked with the mechanism that the switch cannot be placed in the running position without having first been thrown into the starting position. This latch also makes a quick change from starting to running position necessary to prevent the switch being caught at the off point.

There are a number of other enclosed switches for this service now on the market. In two of the new types which have come to the writer's notice the operation of throwing over from starting to running position is done automatically by a spring arrangement at the instant the handle has been released by the operator after having been moved into the starting position. All types must be arranged so the switch cannot be left in the starting position since in this position the motor is without fuse protection. Further under these conditions the motor could not carry its full load.

A number of the later switches are of the so-called interlocking type. In these switches the fuses are placed in a separate compartment which has a door so interlocked with the handle that the fuses are accessible only when the switch is in the off position.

An oil-immersed drum type switch designed for this method of starting is illustrated in Fig. 2. There are three sets of contact fingers and segments upon the drum to effect the proper combinations of connections. Like the various switches just described, these drum switches are so arranged that the handle can only be moved into the different positions in the correct sequence. These switches are furnished in capacities up to and including 20 h.p. at 220 volts and

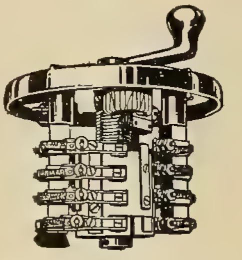


Fig. 2. Drum Type Star-Delta Switch of Cutler Hammer Manufacturing Company

25 h.p. at 440 and 550 volts and in three styles—with low-voltage release only, with low-voltage release and fuses or with low-voltage release and overload relays.

The connections for two of these styles are shown in Figs. 3 and 4 respectively. The push button in the low-voltage release circuit is for the purpose of tripping the switch from some distant point when desired. These buttons should be of the normally-closed type. A number of them may be connected in series when more than one tripping station is required.

By tracing the connections in the different diagrams it will be seen that the fuses are not in the circuit with the switch in the starting position and therefore protect the motor only when running. Note also that because of its position in the circuit each fuse carries the current for only one phase of the motor and therefore should have a rated capacity equal to 57.7 per cent of the full load current of the motor, assuming that overload capacity is not considered. Allowing 25 per cent overload as is now customary, this means that the ampere rating of the fuses should be 57.7 per cent times 1.25 equals 72 per cent of the full load current of the motor. For example, the full load current of the 7½ h.p., 220-volt, 3-phase motor mentioned in the first article, as shown on the motor name plate, was 19 amperes. The running fuses for this motor should then be 72 per cent times 19 equals 13.6 amperes, which would call for a standard 15-ampere fuse.

This point will be clear by referring to Fig. 5. Diagram (a) shows the relative position of the running fuses when the motor is started in the ordinary manner, either by being thrown directly across the line at full voltage as is done with small motors or by means of a suitable starting compensator in connection with the larger sizes. It will be understood that with either method of starting the running fuses are short circuited or removed from the circuit during the starting period.

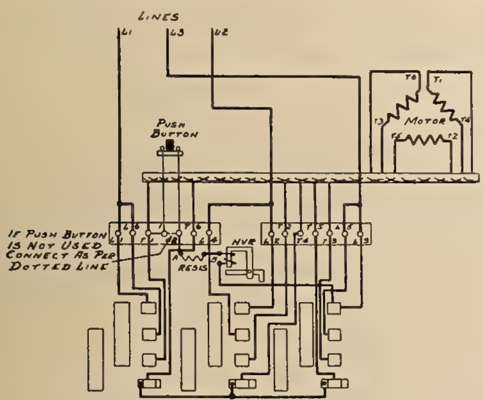


Fig. 3. Drum Type Switch with Low Voltage Release Only

Here the fuses are placed between the line and the junction of the windings and must therefore carry the line current which will be equal to 1.732 times the current in each phase of the winding. Diagram (b) Fig. 5, shows the relative position of the fuses in Fig. 1, after the switch has been thrown into the running position which connects the motor windings in delta. In this case, as explained, the fuses carry the current of only one phase of the motor, hence should be only 57.7 per cent of the capacity required with the fuses in the position shown in Fig. 5, (a). This does not mean however that fuses should always be selected in this way. With certain types of star-delta switches or starters the running fuses are finally connected into the position shown in Fig 5 (a). Therefore in every case the position of the fuses should be determined before their capacity is chosen.

If overload relays are used instead of fuses it is better to connect them so they will be in the main leads to the motor,—that is, in the same relative position as the fuses in Fig. 5 (a). In this position the capacity of the relay coils should be equal to the full load current of the motor, since these relays are generally designed to carry 25 per cent overload to agree with the present standard overload rating of motors. Placing the relays in this position will in many cases make the wiring easier and less complicated. Further there is the advantage that the relays will be of the proper capacity for use with a compensator should it be desired to start the motor in this manner at some later time.

In the future more care will be required in selecting relays and fuses as motor manufacturers are now re-rating or re-designing their lines of motors to agree with the new standards of ratings. Certain lines of motors will be given a maximum continuous rating that will not permit of the usual overload capacity. These motors will be known as "50-degree motors." A number of manufacturers already have lines of motors rated on this basis in production and will soon have them available for delivery. These ratings will be particularly suited for applications involving load requirements that are accurately known, such as the driving of individual machines. An article on these new ratings will appear in this department in the near future. For such motors, relays and fuses rated at 110 per cent of the motor amperes will probably be adopted as standard. Here it should also be noted that the usual double-pole circuit-opening relays which are extensively used for motor protection can only be used when starters are equipped with low-voltage coils.

With any type of switch having connections equivalent to those in Fig. 1, a separate main line switch must be installed ahead of the starting switch to completely disconnect the motor from the line. This is as required by the National Electrical Code. A separate switch for this purpose is not required with the drum type switches shown in Figs. 3 and 4 since the motor is completely disconnected with the switch in the off position. This statement would not be applicable in the State of California in connection with those installations that come within the jurisdiction of the Industrial Accident Commission. The electrical utilization safety orders issued by that commission require that fuses, except in certain classes of lighting circuits, shall be disconnected from the source of energy before being replaced. Under these conditions a main line switch would also be required in connection with Fig. 4. Here it is also well to note that section 747 (d) of these same orders prohibits the use of any type of manually-controlled motor starter which does not give low-voltage protection, except where motors are under competent supervision and equivalent protection is otherwise provided.

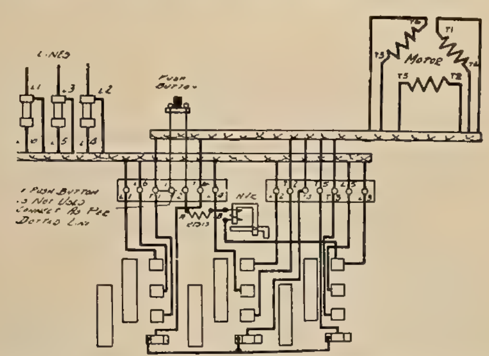


Fig. 4. Drum Type Switch with Low Voltage Release and Fuses

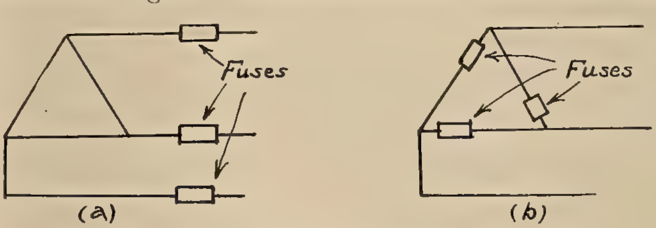


Fig. 5. Fuse Connections for Star-Delta Switches

The star-delta method is not by any means new. It has been discussed in detail because many of our readers do not fully understand it and because quite often it is used when conditions are not favorable thus causing much trouble. Again it seems of particular interest at this time because of the poor deliveries on starting compensators.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Irrigation pumping by means of electrical energy has revolutionized the load curves of many hydro-electric companies throughout the West. Here is an account of how the San Joaquin Light and Power Company, serving the fertile San Joaquin Valley of California, is not only building up a load of immense profit to itself but is contributing a lasting service to the State in assisting the farmers of that wonderful community in producing an annual agricultural output valued at the enormous total of over one hundred and thirty million dollars. This article describes the extent and character of the irrigation pumping load of this community. The author is the valuation engineer for the San Joaquin Light and Power Company.—The Editor.)

UNUSUAL FEATURES OF AN IRRIGATION PUMPING LOAD

BY G. R. KENNY

The San Joaquin Light & Power Corporation is a large hydroelectric company that operates in the San Joaquin Valley portion of the counties of Merced, Madera, Kings, Tulare, and Kern, in California. The territory served has a population of about 250,000. Fresno, with a population of approximately 40,000, is the largest city served.

On January 1, 1917, there were 23,238 electric consumers connected with a total load of 57,567 kilowatts. The total number of irrigation pumping consumers on the same date was 887, with a connected load of 6965 kilowatts, or 12.1 per cent of the total. The consumption of these consumers for the year 1916 was 19,086,776 kw.-hr. or 23.7 per cent of the total kw.-hr. sold. The annual load factor of the business was 31.6 per cent. The monthly and daily load factors are very high.

The possibility of irrigation and intensive farming in the San Joaquin Valley first received attention about 1870. The first irrigation was entirely by gravity ditches.

The appropriation of water for ditch systems had reached almost its present proportions by 1890. At that time the question of ownership and appropriation of water had become very much involved and was settled by litigation extending over several years. The system of lateral ditches and the distribution of water has increased considerably since that time. Steam and gas pumping plants were first used for irrigation in this valley in the 90's. The first electric pumping plant was installed on the Mt. Whitney system in 1900. The San Joaquin Light & Power Corporation, whose predecessors had begun the service of light and power in 1896, connected its first irrigation pumping plants in 1906. Climatic and soil conditions are such that about all known crops can be raised, but necessitate the use of large quantities of water. The summer dry season extends generally from April to October, and the temperatures, particularly in June, July, August, and early September, are high. The daily variations in temperature in summer are usually from 25 to 40 degrees. The annual rain-fall and temperature are shown in the following table. (Table No. 1):

Table No. 1.—Climatological Data

Normal Annual	Merced	Fresno	Bakersfield
Rainfall, inches	14.72	9.67	6.5
Number of rainy days, 1914	44	43	25
Number of clear days, 1914	264	213	302
Mean annual temperature, deg.	..	63	..
Maximum Recorded " " "	..	115	..
Minimum " " "	..	17	..

The following table (Table No. 2) gives the acreage devoted to various crops and the annual value of the total output of the various products of the territory served:

Table No. 2.—Data Covering Acreage and Value of Annual Output of Farm and Other Products in Territory Served

Total area in acres		15,648,610
Area adaptable to agriculture		7,710,000
Area under cultivation—		
Alfalfa	359,400	
Dairying	219,000	
Orchards and vineyards	324,576	
Grain	559,850	
Miscellaneous crops	34,000	
Total area under cultivation		1,496,826
Value of Yearly Output—		
Dairy products		$ 9,160,000.00
Live stock		15,644,720.00
Alfalfa		10,267,000.00
Grain and hay		7,619,800.00
Citrus fruits		13,200,000.00
Raisins		5,260,000.00
Other fruits		14,494,775.00
Oil products		42,724,347.00
Other minerals		2,248,661.00
Lumber		4,300,000.00
Miscellaneous, small crops, mfg., etc.		7,325,765.00
Total value of yearly output		$132,345,068.00

The principal users of power for irrigation pumping are the alfalfa and citrus fruit growers, although all crops raised are irrigated and the area irrigated, to a greater or lesser extent, is practically the entire area under cultivation. In the counties served the 13th U. S. Census taken in 1910 reported 11,935 irrigated farms having a total irrigated area of 1,259,408 acres. In this area there were 1290 main ditches having a length of 2332 miles and 1847 laterals having a length of 3045 miles. In 1910 there were 211 flowing and 1920 pumped wells. The number of pumped wells has now increased to possibly twice this number.

The average quantity of water required annually for satisfactory irrigation for the various crops is as follows in acre feet per acre:

Alfalfa	3
Citrus fruits	2
Raisins, grapes and other fruits	1

The pumping lift varies from averages of 50 ft. to 110 ft. in the foothill regions east of Bakersfield and on the entire east side of the valley where citrus fruits are the principal crops, to 20 ft. to 25 ft. in the greater central section which is devoted principally to alfalfa raising, dairying, grapes, and other summer fruits. The west side of the valley is now attracting considerable attention. The lifts here are from 40 ft. to 90 ft.

At present, some rice is being grown by pump irrigation in the central part of the valley where alkali has prevented the growth of other crops and where the surface soil is underlaid with hardpan and clay. This industry appears to be a success. Electric power

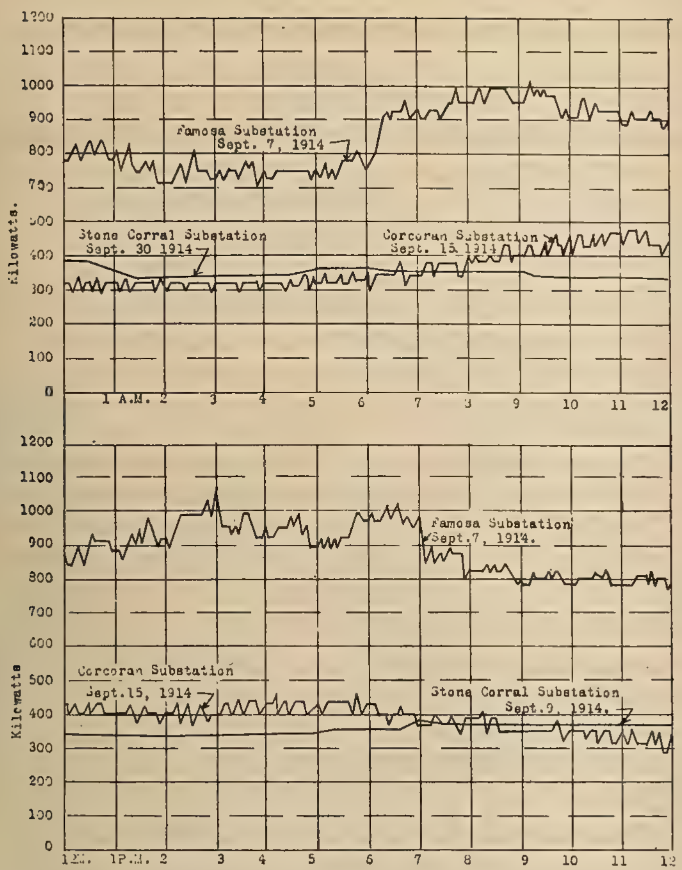


Fig. 1. Typical Daily Load Curves from Substations

is used for pumping almost exclusively. The amount of water required for rice is large, 3 to 5 acre feet per acre.

The effect of the irrigation pumping load is to increase the average summer load on the system over that in winter by about 5000 kw. The annual system peaks occur in August and September and are the result of the shortening days, bringing the lighting peak on top of the irrigation pumping load. The following table (Table No. 3) gives data on the operation of our substations serving practically nothing but irrigation business. The true diversity factor from consumer to substation was 1.16.

Table No. 3.—San Joaquin Light and Power Corporation. Data from Substations Serving Irrigation and Other Agricultural Business Almost Exclusively

Name of Station	Total Demands of Consumers Plus Average Line Drops for System	Sub-station Peaks	Diversity Factor	kw.-hr. for 1914	Load Factor
Famosa	1861.60	1544	1.20	6,129,600	45%
Corcoran	955.60	611	1.56	2,133,560	39%
Stone Corral..	963.25	706	1.36	2,340,000	38%
Madera 10 kv..	1103.99	705	1.57	2,245,920	36%
Totals	4884.44	3566	1.37	12,849,080	4.12%
Average Diversity factor			1.42		

In Fig. 1 are three typical daily load curves taken when the irrigation season was at its height.

The two typical daily load curves in Fig. 2 show the variation in the system load between summer and winter. These curves vary from those taken in 1916 only in the amount of load, the form being almost identical. A peak of 20.800 kw. was reached in August, 1916, and several peaks in excess of 20,000 kw. were recorded in 1916. The daily load factors vary from 60 per cent to 85 per cent. The annual system load factor for 1915 and 1916 was 61.2 per cent in each case.

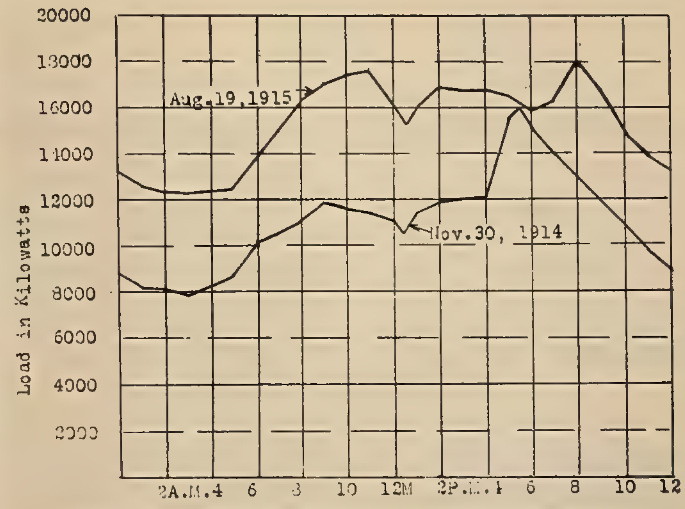


Fig. 2. Seasonal Load Curves of Typical Substations

(Continued from page 444)

between the range peaks. Together with the added cost of the double throw switch, it must be evident that the responsibility on the housewife to always remember to "throw the switch back" can but greatly lessen the value of automatic service.

With a gross minimum revenue of $50.00 earned by 1500 watts of step-thermally controlled apparatus. It is evident that since the 1.5 kw. connected load is imposed in graduated steps of only 250 watts each there is no additional copper, meter or transformer investment required when this type of apparatus is imposed directly on even a 5 kw. lighting service, for the resultant 250-watt-step disturbance has been noted to be less than the imposition of a flatiron or other 660 watt appliance. We will dedicate, however, to this heater its 1.5 kw. pro rata of investment, at $20.00 per kw., or $30.00, which develops a feeder, interest, maintenance and depreciation charge of 15 per cent of $30.00, or $4.50 per year. Deducting $4.50 from our minimum gross revenue of $40.00 per year, we have a net station revenue of $35.00 from 1.5 kw. total connected, or about $24.00 net per annum per kw. connected.

A brief resume of our results, then, shows the non-automatic service earning a net feeder revenue of $3.00 per year per kw. of load against $24.00 per kw. of investment dedicated to the automatic type of heater; or again, a net revenue per consumer of $15.00 per year from the 5 kw. heater against a net revenue of $35.00 earned by the automatic equipment, and lastly a gross revenue of $30.00 for the non-automatic against $40.00 for the step-thermally controllerd.

With respect to revenue per kw.-hr., the non-automatic, consuming 2400 kw.-hr per year, will develop from the above only ⅝c per kw.-hr., whereas the automatic will bring home $35.00 per year net from 3600 kw.-hr. or 1c per kw.-hr., which indicates the error in granting the two types of heaters the same unit rate per kw.-hr. Diversity is not considered for either type of heater, for they will both be on full-capacity during the dish-washing periods, and hence the 5 kw.-heater will develop no great diversity with respect to the domestic feeder alone than the 1.5 kw. heater, similarly considered.

It is not necessary for me to draw any conclusions—the fact standing self-evident is that the only barrier between the $3.00 per kw.-year and the $24.00; between the $15.00 net and the $35.00 net, is the application of properly directed sales effort and intelligence necessary to sell $60.00 worth of automatic service for $40.00 as against the sales effort necessary to sell $30.00 worth of non-automatic service for whatever we can get for it. That is, our net increase is purely a matter of salesmanship and what we go out to get, and it is certain that if we start out with a $30.00 idea it will never bring in $60.00 results.

FUEL OIL AND STEAM ENGINEERING

(The quality of steam, whether wet, dry saturated or superheated and to what extent moisture or dryness pervades its contents are matters of vast importance in steam engineering and fuel oil practice. In the following discussion the reader is told how the superheat of superheated steam is ascertained in practice. How to approximately determine the moisture content in wet saturated steam is also described. In this manner the way is paved for the discussion that is to follow next, which will set forth the exact methods to be used in determining the moisture content by means of the well-known steam calorimeter.—The Editor.)

HOW TO DETERMINE QUALITY OF STEAM IN FUEL OIL PRACTICE

BY ROBERT SIBLEY AND CHAS. H. DELANY[1]

Thermometer Inserted for Superheat Measurement

STEAM as used in engineering practice is said to be wet saturated, dry satuated or superheated, depending upon the degree to which heat has been applied in its generation.

Wet Saturated Steam.—As its name implies, wet saturated steam is saturated steam in which are suspended small globules or particles of water. Since such globules or particles of water indicate that insufficient heat has been applied, and consequently steam generation is imperfect, it is the function of all good boilers to generate steam as free from water as is possible.

Although steam be generated dry or even superheated it may, however, after passing through conducting pipes appear at the power generating unit in a wet condition. Hence the determination of moisture content and the heat loss due to its presence is an important one in steam engineering.

Let us assume X to be the proportion by weight of dry steam that exists in wet saturated steam. Then the total heat represented in every pound of such saturated steam at temperature t is

$$H_t = h_t + XL_t \quad \ldots\ldots\ldots\ldots (1)$$

This is evident at once when we consider that to raise each pound of original water from 32° F. to the temperature t, it required h_t heat units. On the other hand since a proportion by weight equal to X has actually gone into steam, the heat required in the latent heat of evaporation is but XL_t.

Dry Saturated Steam.—As one may infer from the heading, saturated steam that contains no moisture is called dry saturated steam. In the chapter on properties of water the determination of its total heat was illustrated quite fully. We may, however, derive the equation for total heat of dry saturated steam from the equation above for wet saturated steam. For in this latter instance since no water is present, evidently X becomes equal to unity. Hence for dry saturated steam

$$H_t = h_t + L_t \quad \ldots\ldots\ldots\ldots (2)$$

Superheated Steam.—It has been hitherto pointed out that when water is being evaporated into steam the temperature remains constant until all the water disappears. So long, however, as steam remains in contact with the water from which it is being formed it is either dry or wet saturated steam and its temperature cannot be raised above that which normally represents the boiling point of water for the pressure under which the steam is being generated.

It has, however, been found of immense economic value in steam engineering practice to actually use steam that is heated over a hundred degrees in excess of the temperature at which saturated steam may be generated under the existing pressure conditions. It is seen that such steam must, of course, first become absolutely dry and then any additional heat that may be added goes toward raising its temperature if the pressure be kept constant.

This is accomplished in the modern steam generating units by conducting the saturated steam from the main drums in which it is generated and passing it through pipes exposed to highly heated portions of the boiler furnace. Such a system of pipes is known as a superheater. The steam quickly absorbs sufficient heat to completely dry it and still further raise its temperature.

Computation of Total Heat of Superheated Steam.—If a definite constant quantity of heat were required to superheat a pound of steam one degree in temperature for all ranges of temperature and pressure, we could write down a comparatively simple formula for arriving at the total heat of superheated steam. Since, however, this specific heat constant has a wide range of .46 to .60 it is impossible to do so.

Hence in each case of temperature, pressure and degree of superheat, we must refer to steam tables in order to find the proper value of total heat of superheated steam. And, indeed, this too is necessary to find all the other constants that relate to superheated steam.

The fundamental definition remains the same, however—namely that the quantity of steam required to raise one pound of water from 32° F. to the temperature t corresponding to the boiling point of water for the pressure at which the steam is generated, added to the latent heat of evaporation for this pressure, together with such additional heat as may be required to raise the one pound of now dry saturated steam to the degree of superheat given, is known as the total heat of superheated steam H_s. Expressing this algebraically we have

[1]For an important announcement see editorial, page 454.

$$H_s = h_t + L_t + C_{pm}\,(t_s - t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

As an example let us suppose that superheated steam is being generated at ordinary atmospheric pressure and delivered at a temperature of 312° F. We will suppose that the mean specific heat C_{pm} for the range of temperature and pressure under consideration is say 0.46. Then from the tables, we find

$h_t = 180.$ $L_t = 970.4.$ $t_s = 312°.$

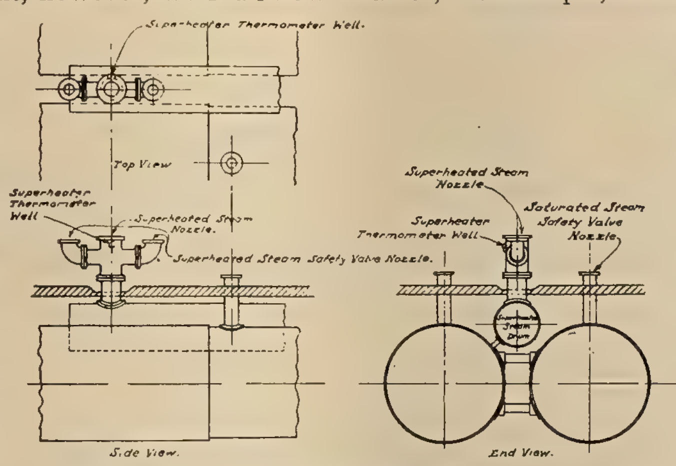
$t = 212°.$ $C_{pm} = .46$

$$\therefore H_s = 180 + 970.4 + .46\,(312 - 212)$$
$$= 180 + 970.4 + 46 = 1196.4 \text{ B.tu,}$$

It is most important that the student should remember that although the value H_s may be taken directly from the steam tables, still it is based on the several steps above taken. In many steam engineering problems this separate analysis or dissecting must be done so it is well to clinch this matter without delay.

Steam Calorimeters.—The word calorimeter often causes considerable confusion because there are two entirely different and distinct types of mechanism that bear this name in engineering practice. Fundamentally it means "a measurer of heat." In order to determine the heat contained in fuel an instrument known as a calorimeter is employed which will be described in later pages. At this point, however, we shall now proceed to describe several types of an instrument that bears the same name and yet is entirely different both in design and in aim to be accomplished.

The steam calorimeter is an instrument used in steam engineering practice to determine the exact quality of steam, whether it be wet saturated, dry saturated, or superheated, and to what extent. Since the thermometer and the carefully calibrated pressure gage constitute the easiest and most direct method of ascertaining superheat, the uses of the steam calorimeter are usually limited to determination of moisture in wet saturated steam.



TEMPERATURE DETERMINATION FOR SUPERHEATED STEAM

In taking the temperature for superheated steam a thermometer should be inserted as near the superheated drum as practicable. The thermometer has suspended at its side a second thermometer in order to ascertain the proper correction to be made for that portion emerging from the bath in which the main thermometer rests so that the stem correction may be made. In the illustration may be seen the point at which the thermometer well for ascertaining the superheated steam temperature was inserted in finding the superheat for an installation in Oakland, California.

The Determination of Superheat.—The method of ascertaining superheat will now be set forth.

A thermometer is inserted in the outlet of the superheater drum, and the temperature read, and at the same instant the pressure of the superheater drum is read on a steam gage attached to this drum. If now the thermometer reads 539° F. and the steam gage reads 178.5 lb. per sq. in. and the atmospheric pressure is 14.7 lb. per sq. in., we proceed as follows:

The absolute pressure of the superheated steam is the sum of 178.5 and 14.7 which is 193.2 lb. per sq. in. Referring to steam tables, we find that water boils, or rather saturated steam is generated, at a temperature of 379° F. when under a pressure of 193.2 lb. per sq. in. Hence, the superheat of the steam under consideration is the difference of 539° and 379°, which is 160° F.

Determination of Moisture in Saturated Steam.—There are many methods that may be used in determining the moisture content of saturated steam. The particular method to be employed depends much upon the accuracy desired and the degree or intensity of the moisture content present.

The Barrel or Tank Calorimeter.—In this method, which should never be used except for approximate results, the steam is allowed to pass up through a barrel of water. Of course, the steam at once condenses into water and the resulting mixture with the water in the barrel raises the temperature. By taking the pressure of the steam and the two temperatures of the water—the one before applying the steam and the other after its application together with the weights of the water involved, we may at once write a mathematical relationship to determine the moisture content.

If we neglect radiation and other stray losses, the heat gained by the water in the barrel is equal to that lost by the steam under test.

In all the subsequent discussions in this chapter let us let 0 subscripts represent conditions of steam in the boiler; 1 subscripts, the initial conditions in the barrel; 2 subscripts, the final conditions in the barrel; and W will represent the weights involved.

The total heat of each pound of entering steam is by equation (1) found to be $(h_0 + X_0L_0)$ and since after this pound of condensed steam mixes with the water in the barrel it still has h_2 units of heat, there is then a net loss of $(h_0 + X_0\,L_0 - h_2)$ heat units. In the same way each pound of water in the barrel gains $(h_2 - h_1)$ heat units. If W_0 units of steam are involved and W_1 units of water are found in the barrel at the beginning of the test, we know then, since heat lost by the steam is equal to heat gained by the water, neglecting radiation and other losses, that

$$W_0\;(h_0 + X_0\,L_0 - h_2) = W_1\;(h_2 - h_1)$$

$$\therefore X_0 = \frac{W_1\,(h_2 - h_1) - W_0\,(h_0 - h_2)}{W_0\,L_0} \quad \ldots\ldots (4)$$

As an example, it was found in a test that a steam main under 90 lb. pressure (gage) deposited 3 lb. of condensed steam into a vessel that contained 27 lb. of water at 62° F., thereby raising the temperature to 175° F. We compute the proportion of dry steam in the main as follows:

$P_0 = 90$ lb. per sq. in. (gage) $= 104.7$ lb. per sq. in. abs,

$W_1 = 27$ lb., $W_0 = 3$ lb. $t_1 = 62°$ F., $t_2 = 175°$ F.

Hence from steam tables—

$L_0 = 885.4,\ h_0 = 301.8,\ h_1 = 30.1,\ h_2 = 142.9.$

$$\therefore X_0 = \frac{27\,(142.9 - 30.1) - 3\,(301.8 - 142.9)}{3 \times 885.4} = .968$$

$\therefore X_0 = 96.8\%$ dry steam in steam under test.

Surface Condenser Tank Calorimeter.—This method varies from the one just set forth in that the condensed steam does not mingle with the water in the barrel. To accomplish this the steam is passed through a coil of piping which is inserted in the tank. As the steam comes in contact with the cooling surface of this pipe, it is condensed into water and of course the heat thus liberated or given out is absorbed by the water in the tank and its temperature correspondingly raised. Hence in this instance, it is necessary to weigh the water in the tank and the condensed steam discharged through the coil. It is also necessary to take the pressure of the steam under observation and to note the temperature of the tank water before and after application as well as the temperature of the water discharged from the coils.

Proceeding by similar reasoning as set forth in the former instance, the heat lost by each pound of steam is sure to be $(h_0 + X_0 L_0 - h_3)$, wherein the subscript 3 is to denote the condition of the steam condensed into water as it emerges from the coil. The heat gained by each pound of water in the tank is also seen to be $(h_2 - h_1)$ heat units. Hence if W_0 lb. of condensed steam are discharged and W_1 lb. of water are found in the tank, since the heat lost by the steam is equal to that gained by the water, neglecting radiation and other minor losses, we have

$$W_0\,(X_0 L_0 + h_0 - h_3) = W_1\,(h_2 - h_1)$$

$$\therefore X_0 = \frac{W_1\,(h_2 - h_1) - W_0\,(h_0 - h_3)}{W_0 L_0} \quad \ldots\ldots (5)$$

To illustrate, let us assume that one pound of steam at a pressure of 100 lb. per sq. in. absolute is passed through coils immersed in a tank containing ten pounds of water at an initial temperature of 100° F. At the conclusion of the condensation the water in the tank is found to be at a temperature of 204.5° F., while that emerging from the coils is 210° F. The quality of the steam is at once found by substitution in the formula as follows:

From the test data we have $p_0 = 100$ lb., $W_1 = 10$ lb., $W_0 = 1$ lb., $t_1 = 100°$ F., $t_2 = 204.5°$ F., and $t_3 = 210°$ F. From the steam tables, we find $h_1 = 68$, $h_2 = 172.5$, $h_3 = 178$, $h_0 = 298.3$, $L_0 = 888.0$.

$$\therefore X_0 = \frac{10\,(172.5 - 68) - 1\,(298.3 - 178)}{1 \times 888} = 1.05$$

Since the quality of steam is greater than unity, it is evident that the steam in this instance is superheated.

The principle upon which the more accurate steam calorimeters operate is in general accomplished along similar lines. We shall, however, reserve further discussion on the subject until the next chapter wherein we shall deal at length with these calorimeters.

LETTER TO THE EDITOR ON WIRING PROBLEMS

Martinez, Cal., April 23, 1917.

Sir: Will you please advise me on the following problems in interior wiring. Are they permissible under the National Electric Code? Are they safe?

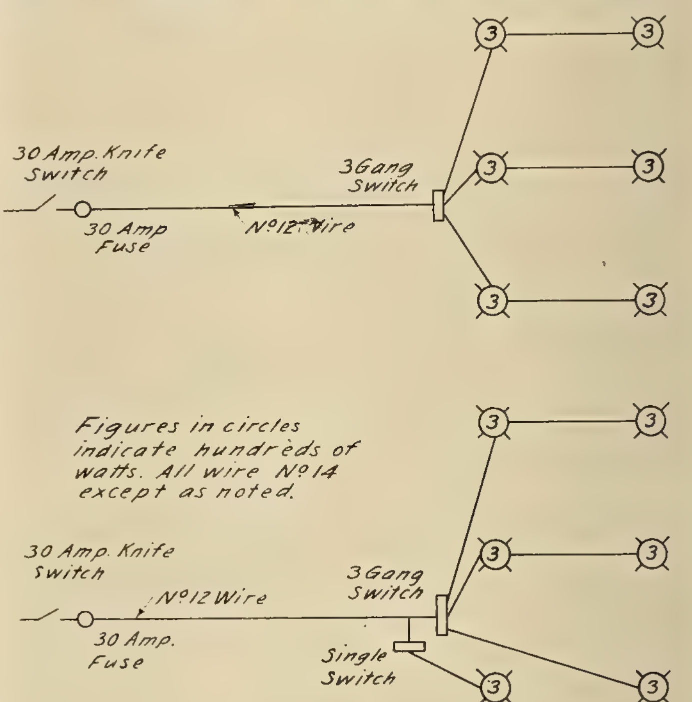
All wire double braided, rubber covered, in conduit in a concrete building; conduit bedded in the concrete.

An early answer will be very much appreciated as this is for an actual building, the construction of which will commence very soon.

Yours truly

MORRIS WENK.

Mr. C. W. Mitchell, electrical engineer for the Board of Fire Underwriters of the Pacific advises us that circuits as shown are overloaded. Section 23-d of the National Electric Code provides that not more than 660 watts shall be de-



A Problem in Wiring

pendent upon one cut-out. However, by special permission in cases where wiring equal in size and insulation to No. 14 B. & S. gauge approved rubber-covered wire is carried direct into either socket or receptacle, and where the location of sockets or receptacles is such as to render unlikely the attachment of flexible cord thereto, the circuit may be so arranged that not more than 1320 watts will be dependent upon the final cut-out.

If single conductors are used, wires need not be double braided as you specified. If twin, twisted pair or multiple conductor cables are used, then they should be double braided. In this connection please refer to Section 26-n of the Code.—The Editor.

To move one field army of eighty thousand men, technically known as a brigade, of field army troops, requires a total of six thousand two hundred and twenty-nine cars made up into three hundred and sixty-six trains with as many locomotives. These six thousand two hundred and twenty-nine cars would include two thousand one hundred and fifteen passenger, three hundred eighty-five baggage, one thousand and fifty-five box, one thousand eight hundred and ninety-nine stock and seven hundred seventy-five flat cars. Inasmuch as the army plans to move a million men, the railroads have a man's size job ahead of them.

SPARKS—Current Facts, Figures and Fancy

(Even the extinct craters of volcanoes are being utilized in the West for the storage of water as detailed in a fifty thousand dollar expenditure found below, which has received the sanction of the Corporation Commission of Arizona. Many other opportunities await but the magic touch of enthusiastic thought in the West, inspiration for which you may perchance catch by reading some of the "Sparks" detailed below.—The Editor.)

Eugene Christian has said that the best business man is he who can best harmonize his business affairs with his health, his happiness, and the philosophy of life.

* * *

From one of our contributors, with apologies to May issue of System, the suggestion is made to stencil, in bright paint, all ash cans so as to read: "Don't lug ashes all your life, Cook Electrically."

* * *

In Europe community forests have long been established and yield good returns on the investment they represent. The Swiss city of Zurich, for example, derives about twenty dollars per acre per year from a woodlot of twenty-five hundred acres.

* * *

In spite of the scarcity of oil scare that has received prominence in certain quarters the records show that five hundred sixty-three new oil and gas companies have been formed since the beginning of the war with an authorized capital stock of $666,000,000.

* * *

As central station representatives often have opportunities to talk before women's clubs and domestic science classes, it is felt that the well prepared lecture and lantern slides for this purpose, prepared by the National Electric Light Association, would be of advantage.

* * *

Contrary to general opinion the farm woodlots of the country not only furnish immense amounts of material for local use, but are important sources of supply for timber for the general market. Much of the choice hickory, ash, and white oak now in use comes from farm woodlots.

* * *

The largest turbine so far developed is rated at 70,000 kw. and the largest condenser on order has 100,000 sq. ft. (30,480 sq. m.) of surface. Many industrial plants are now installing units rated at 10,000 kw. and 15,000 kw., where 2000 kw. or 3000 kw. was considered large until recently.

* * *

The United States Attorney General has recently ruled that any alien enemy who tears down, mutilates, abuses, desecrates, or insults the United States flag in any way or displays an enemy flag or insignia is to be regarded as a danger to the public peace or safety and subject to summary arrest and confinement.

* * *

It has been suggested that some sort of co-operative school for teaching electric range cooking would be advantageous, and this, in turn, might be made the basis of a school operated by central stations, so that the electric range may be advertised through the training of those having to do with the cooking in the home.

* * *

The shipping board's survey of ships interned in the ports of the United States has disclosed that the three great steamships of the Hamburg-American Line—the President Lincoln, the President Grant, and the Pennsylvania—are the most extensively damaged of the German vessels. The repairs on each of these ships will approximate two hundred and fifty thousand dollars.

* * *

Attention is called to the importance of power company engineers co-operating with telephone engineers in the solution of inductive interference problems and informing themselves as to the principles on which means for mitigation of induction are based, so that they may be thoroughly familiar with the conditions in power systems which are likely to lead to inductive troubles.

* * *

Theodore P. Shonts of the New York Railways Company is impressing upon his host of employes that a street car conductor has three kinds of duties. First, he is in charge of the safety of his passengers. Second, he is a cashier and accountant. Third, he is an information bureau for passengers. These duties must be performed under all kinds of conditions, and always with courtesy and consideration for the public.

* * *

The consensus of opinion regarding the merchandising of appliances by central stations seems to be that they should be sold at a profit. This should be the goal toward which they should work with electric ranges, and the utmost help from all concerned is necessary to bring it about. Some central stations look forward to the time when electric ranges can be handled by dealers at a profit without the bonus for such sales which in some instances the central stations are paying at the present time.

* * *

The Corporation Commission of Arizona has granted permission for a corporation to pipe water from extinct craters lying in the greater altitudes above the city of Flagstaff to adjacent towns, so far away even as Ash Fork, Kingman, Seligman and Grand Canyon, and to ranches lying between. The line also will be the source of water for the locomotives, roundhouses and shops of the Santa Fe Railway. The United States Government has granted right of way for the pipe lines across the national forest intervening. The company already, has expended $50,000 in the enterprise.

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CONTENTS

THE LIBERTY LOAN

The spirit of patriotic helpfulness is universal in America. From all over the country have come offers of co-operation from the newspapers and technical journals in the selling of the war bonds—The Liberty Loan of 1917. The government desires not only that the five billion dollars of bonds be sold promptly but that these bonds be as widely distributed among the American People as is possible. Engineers of the West know their duty and in the subscribing to this great patriotic move they will not be found wanting. Buy a bond for baby "bumpkin" now.

Youth in the West

An interesting thing about the estimated allotment for men of the draftable age from statistics of the U. S. Bureau of Census is the remarkable preponderance of youth in the West over other sections of the nation. Take the case of California for instance. In 1910 there were ten other states that exceeded her in population as a whole. When counting men of the draftable age at that date, however, only seven states exceeded her, while from present estimates it would appear that the Golden State is now at this date exceeded by but five other states out of the forty-eight.

The preponderance of youth in Western commonwealths augurs much for the future of this section. Her engineering achievements have long dazzled with their effective accomplishment the older and more conservative communities of the world. May her youth assist in making the world safe for democracy with the same brilliant and ever-conquering force shown in her past achievements in engineering.

Fuel Oil and Steam Engineering

Fuel oil and steam engineering discussions continue to hold the attention of engineers throughout the West. Since the first of the year this series of articles published in the columns of the Journal has created such wide spread interest and called forth such interested inquiry on the part of the readers of the Journal that this department in the future will be amplified and extended.

Beginning with this issue these discussions on fuel oil and steam engineering will be under the joint authorship of Robert Sibley, editor of the Journal of Electricity, and Charles H. Delany of the Pacific Gas & Electric Company.

In its entirety this series of articles will contain discussions of all important practical features involved in fuel oil and steam engineering practice. The principles involved will be set forth where necessary in simple mathematical treatment. No calculus will be used. Practical applications and industrial devices used in steam power plant practice will be discussed in their completeness and the closing chapters of the thirty-one distinct discussions will be devoted to set-

ting forth for the first time, definite and complete detailed forms for boiler testing in fuel oil practice.

It is believed that the joint authorship of Mr. Delany, who for so many years was an investigator with the Babcock & Wilcox Boiler Works and today is a well known authority on fuel oil applications in steam auxiliary practice, combined with the long experience of Mr. Sibley, as a teacher of these subjects, while holding the chair of mechanical engineering at the University of California, presents to the readers of the Journal an unusual combination for the discussions involved.

Conserve Fuel and Safeguard Service

Men of the electrical industry have followed with manifest approbation the recent move made by federal, state, and municipal authorities to protect the industrial activity of the nation. Thoughtful men who have within their power the directing of the public policy of the great hydroelectric activities throughout the West have not been slow in realizing the tremendous new responsibilities put upon their shoulders by the exigencies of the national crisis.

The question now to be considered is the immediate move to be made in order to conserve the fuel supply and safeguard the service of hydroelectric plants throughout the West.

In this section of the country crude petroleum is largely used as fuel and it is of utmost importance that its use should be curtailed in every reasonable manner possible. This can be accomplished by making the great powers in the mountain waters of the West available to their utmost.

A forceful instance of how fuel oil supply may be vastly conserved and the continuity of central station service placed upon a plane hitherto unattained is to be seen in California. Feeding San Francisco's great industrial districts are three large hydroelectric companies. Three great steam plants operated by fuel oil are required to assist the water power plants in the mountains. Interlinked, a vast saving could be effected, since the shortage of hydroelectric power in the one could be met by a call for hydroelectric power from the other oftentimes without a call upon the steam plant.

Stretching to the south into Los Angeles and its contiguous territory are three other large hydroelectric companies. Many smaller companies also pass through fertile valleys and serve thriving communities in this same commonwealth.

All of these power companies are consumers of vast quantities of crude petroleum and yet linked together the various loads could be made so to dovetail as to make a maximum use of water power and a minimum consumption of fuel oil. Here is an opportunity for real co-operative effort. Already many of these companies are interlinked but the connections as a rule are of insufficient capacity to carry the real burden should heavy duties arise due to disruption of service continuity.

This entire commonwealth should be made one gigantic network of interlinked pulsating energy. Such costs as may be involved should be considered from its emergency basis. Its early accomplishment is a necessary war move and the governor of the state, the fuel oil conservation commission, the council for defense and the managers of all power companies in California should take action immediately to bring about this step which will so positively accomplish conservation in crude petroleum and secure the highest attainable continuity of service.

Women in the Engineering Industries

Thoughtful men in hours of quiet reflection are speculating as to how this dear old world of ours will look after the thorough combing and grilling it is getting during the present strenuous days. The question of the possible entrance of women into the engineering industries due to the national crisis is of such vital importance to engineers that its discussion should receive full and unbiased treatment in the columns of the Journal. Undoubtedly the present war situation, whether we wish it or not, will force upon the engineering world the entrance of women in practically every phase of the engineering industries.

At a recent exhibit in England staid engineers of the present generation were simply amazed at the pictures displayed portraying the present activities of women in the United Kingdom, forced into these new lines of endeavor and yet withal making good in every way. Before the war these pictures would certainly have been unbelievable and would undoubtedly have been relegated to the curiosity shop where alone the dreamer dreams his dreams of unreality. But here they were displayed in actual reality—women engaged in a host of operations involving engineering in general, ship-building and marine engineering, tool-room and precision work, small arms works, the manufacture of parts of internal combustion engines; they show them engaged on wiring and rolling mills, operating all kinds of lathes and similar machinery, buildture work, assembling ironclad switchgear, erecting switchboards, driving 40-ton cranes, in charge of motors on industrial installations, driving electric trucks, operating a 500 kw. switchboard and attending a 300 kw. direct coupled set and a 1000 h.p. steam engine.

This entire question is not one of idle prattle for theorists. Its actual reality in this country may be upon us for solution in but a few months ahead. We should consider it from its broadest viewpoint. The women of our communities we must remember are our wives, our mothers, our sisters and our daughters. Steps should be taken at once to give them the highest training possible to meet the emergency.

And when the cloud and smoke of battle have cleared, unveiling a better and more harmonious world, may we not hope, too, that the emancipation of womankind may prove so effective and the reward of her patient suffering in the homes and in the industries so complete that she, too, may be included, so that we may all with one accord in reverence and with bowed heads say: "Yes, the world is itself at last free."

PERSONALS

H. B. Squires, electrical manufacturers' representative, has returned to San Francisco from an Eastern trip.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, has returned to his San Francisco office from the East.

C. O. Martin, salesman with the Benjamin Electric Manufacturing Company, has returned to San Francisco from an extended trip through Southern California.

Geo. I. Gilchrest, research engineer with the Westinghouse Electric & Manufacturing Company at Pittsburgh, is studying transmission line conditions in California.

W. F. Allison, professor of highway engineering at the University of Washington, is at the Presidio in San Francisco training for the U. S. Officers' Reserve Corps.

F. W. Paterson has left the sales organization of the General Electric Company at San Francisco to take charge of switchboard sales for the company at Schenectady.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is expected to return to San Francisco from a trip East in the early part of June.

L. A. Schloss, sales agent with the General Electric Company at San Francisco, has received his commission as first lieutenant in the officers' reserve corps and is now in the training camp at the Presidio.

G. D. Longmuir has resigned as district manager of the Pacific Power & Light Company at Pasco, Wash., to engage in business for himself with the Reliance Electric Company of Tacoma, of which he is one of the incorporators.

C. W. Mitchell, electrical engineer for the Board of Fire Underwriters of the Pacific has left for Chicago to attend the meeting of the Electrical Council of the underwriters laboratories which consists of twenty-eight members of that organization.

Paul A. Sinsheimer, head of the stock and bond department of the Railroad Commission of California for five years, has resigned his position to become assistant to the President of the Union Trust Company of San Francisco.

L. J. Corbett, dean of the department of electrical engineering, University of Idaho, has been appointed by Governor Alexander as one of the members of a state board of examiners of architects in accordance with the provisions of a law passed at the last session of the Idaho legislature.

Morton Macartney, city engineer of Spokane, was recently elected president of the Spokane Engineering & Technical Association at the annual meeting of the board of directors. Other officers for the ensuing year are: P. E. Morgensen, first vice-president; W. H. Linney, second vice-president; Carl Uhden, third vice-president; B. J. Garnett, secretary-treasurer.

E. J. Walsh, manager of the Tacoma District Heating Company, has tendered his resignation. **H. G. Lee**, chief engineer of the company, has been named as Mr. Walsh's successor. Before coming to Tacoma, Mr. Walsh was well known in Oregon industrial circles, having installed the system of the Northwestern Electric Company in Portland and the Port of Astoria docks.

Charles H. Lee announces that he has been assigned to duty as an engineer officer of the officers' reserve corps and during his absence his practice as consulting engineer will be directed by **W. K. Barnard**, Mem. Soc. Civil Engineers, of the firm of Leeds & Barnard, consulting engineers. **Raymond Matthew**, formerly head of the department of irrigation at the New Mexico College of Agriculture, will continue in his position as assistant engineer to Charles H. Lee and under Mr. Barnard's direction will be in immediate charge.

Lewis A. McArthur, general manager of the Pacific Power & Light Company, has been elected a member of the executive committee of the Northwest Electric Light & Power Association in the place of J. E. Davidson, resigned. **G. W. Talbot**, president of the Pacific Power & Light Company, has been appointed a member of the public policy committee in the place of Mr. Davidson.

O. C. Merrill, chief engineer of the Forest Service, with headquarters at Washington, though for many years a resident of San Francisco and vicinity, has just issued an interesting and instructive bulletin, in which he sets forth the manner in which the Forest Service is opening up the National Forests by road building under the proposed expenditure of twenty million dollars by the Federal Government during the next ten years.

Boyd Ehle, who will be remembered by his Western friends as resident engineer for Sanderson & Porter at Victoria, is looking after the wooden ship-building work which Sanderson & Porter contemplate carrying on for the government at Willipa Harbor, Wash. His headquarters are at Seattle. **J. S. Thornton**, manager of the Willipi Electric Company at Raymond, is also devoting much of his time to fathering the project as is likewise **P. A. Bertrand**, manager of the Gray's Harbor Railway & Light Company at Aberdeen, Wash.

M. A. De Lew, representing the Electrical Contractors' Association; **C. F. Collonan**, representing the Independent Electrical Contractors; **J. McKnight**, representing Local Union No. 6, Electrical Workers; **C. W. Mitchell** and **G. A. Cleary**, alternate, representing the Board of Fire Underwriters of the Pacific; **Arthur Kempston**, chief, department of electricity; and **S. J. Lisberger**, representing the Pacific Coast Section, N. E. L. A., have been appointed by the committee of public buildings of the board of supervisors of San Francisco for the purpose of revising the electrical ordinances of the City and County of San Francisco. The committee earnestly requests any suggestions, changes or amendments which would be of advantage to the electrical trade generally. Suggestions should be submitted in writing in order that the committee may have an opportunity to consider them.

T. E. Burger has resigned as assistant sales manager for the Western Electric Company on the Pacific Coast to become manager for Baker-Joslyn Co. at Los Angeles. This is another example of the strong hold that Southern California takes upon those who have once lived there. "Ted" Burger was with the Western Electric Company at Los Angeles for eleven years, having been manager of the house during the past seven years. Early in the present year he was promoted to the position he has just resigned, but the call of the South was irresistible, he could not get Southern California out of his bones, especially as his property holdings in that section of the country required his personal attention. Consequently, when the opportunity presented itself to acquire a proprietary interest in the Baker-Joslyn Company and direct their activities in Southern California, he decided to take up the new work. His many friends unite in wishing him all success, not least of whom are his former associates in the Western Electric Company.

MEETING NOTICES FOR ELECTRICAL MEN

(The Northwest Electric Light & Power Association convention at Spokane during September constitutes the most important date ahead for men of the electrical industry throughout the West. Not only are the men of this association themselves working for the success of this gathering but their enthusiasm has spread to the states to the south in such a contagious manner that active efforts are even now being made to formulate a special for the transporting of men of California and other states up via Portland and Seattle to attend this gathering. Details of the tentative program will be found below as will also be found other notations on meetings of interest to men of the electrical industry throughout the West.—The Editor.)

The Northwest Electric Light and Power Association

The program for the coming convention to be held in Spokane on September 12, 13, 14 and 15, 1917, is being rapidly brought to completion. Due to the N. E. L. A. and other fraternities calling off their conventions, some apprehension has been felt by certain of the membership as to whether or not the convention would be held as usual. This matter has been taken up with the prominent members of the association and it is felt that it is the duty of the president of the association to bring the convention to a successful conclusion, thereby expressing our confidence in the stability of our national government, and therefore it will be necessary for all of the members to bend their energies and assert their aggressiveness to a greater degree than ever, in order to accomplish this. Indications now point to a large delegation from other sections. The material so far gathered for the papers is of a very superior quality.

The program at this date, there being some changes in the personnel of some of the committees, and some additions, is as given below. The Washington association of electrical contractors and dealers will hold its first session in Thursday, September 13, instead of Wednesday, the 12th, as previously announced.

Wednesday, Sept. 12, 10:30 a. m.

Address of Welcome by the Mayor of Spokane.

Response by D. L. Huntington, president of the W. W. P. Co.

Committee reports.

President's address.

Paper by J. C. Ralston, a member of the American Society of Civil Engineers, entitled "Aphorisms."

Wednesday, Sept. 12, 2:00 p. m.

Paper, "Practical Central Station Salesmanship."

Editor-Chairman, Lewis A. McArthur, Pacific Power & Light Co., Portland; George Bowen, Northwestern Electric Co., Portland; S. A. Hoag, Puget Sound T., L. & P. Co., Seattle; H. W. Lines, Portland Ry., L. & P. Co., Portland; Lewis A. Lewis, Washington Water Power Co., Spokane; C. R. Young, Pacific Power & Light Co., Portland.

Thursday, Sept 13, 10:00 a. m.

Paper, "How the Engineer Can Assist the Commercial Department."

Editor-Chairman, D. F. Henderson, Washington Water Power Co., Spokane; Gilbert L. Duffy, Puget Sound Traction L. & P., Seattle; J. C. Henkle, Portland Ry., L. & P. Co., Portland; A. S. Hall, Pacific Power & Light Co., Portland; L. T. Merwin, Northwestern Electric Co., Portland.

Thursday, Sept. 13, 2:00 p. m.

Paper, "Co-operation in Modern Home and Apartment House Wiring Practice."

Editor-Chairman, A. C. Micken, Portland Ry., L. & P. Co., Portland; H. H. Schoolfield, Pacific Power & L. Co., Portland; L. R. Grant, Puget Sound T., L. & P. Co., Seattle; F. O. Broili, Northwestern Electric Co., Portland; Foster Russell, Washington Water Power Co., Spokane.

Thursday, Sept. 13, 8:00 p. m.

Illustrated lecture on "Commercial and Residential Illumination," by Mr. F. D. Fagan, manager G. E. Lamp Department on Pacific Coast.

BUILDERS OF THE WEST—VI

FRANK G. BAUM

The harnessing of water powers throughout the West has brought about unusual feats in engineering accomplishment that have been equaled in no other part of the world. In less than two and a half decades distances in transmission have grown from twenty miles to over five hundred, and voltages from five thousand to a hundred and seventy thousand. And the end is not yet. To F. G. Baum, an engineer of unusual gifts in installation and design of great hydroelectric plants not alone in this country but in our foreign neighbors to the south, this issue of the Journal is dedicated. And in this dedication emphasis is not laid so much on the gigantic material accomplishment of the builder as upon the spirit of confidence and fearlessness with which mechanical and electrical truths have been brought out in such great creations.

Note: This will be highly interesting both to the convention and the public. The largest theater in the city will be engaged and all are invited to attend this lecture, which will be found both profitable and entertaining.

Friday, Sept. 14, Both Sessions

From 10:00 a. m. to 12:00 m., and 2:00 p m to 5:00 p. m., will be devoted to the Range Committee Report, Mr. W. R. Putnam of the Utah Power & Light Company, Salt Lake City, Utah chairman.

In connection with this report a paper will be read by Mr. H. B. Peirce of The Washington Water Power Company, on "Bus-Bar Diversity of Ranges" and one by Mr. B. L. Steele, professor of physics at the Washington State College at Pullman, Washington, giving results of certain tests made, as outlined in a previous bulletin.

Friday, Sept. 14, 7:30 p. m.

The usual banquet will be held in the Elizabethan room, Davenport's. (Informal).

Note: Visiting ladies will be adequately entertained each day.

The Program Committee feels the importance of continuing, year after year, a paper or bulletin entitled "Experiences and Wrinkles," the same to be compiled this year by Mr. Lewis A. Lewis of The Washington Water Power Company, Spokane. As outlined in my previous letter, a "Wrinkle" is defined as being "any device, short cut method, or experience, which has been worked out and used to advantage in carrying on your business." This of necessity cannot be a one-man production so I urge on you, in behalf of the editor, to send him any experiences or wrinkles which you may have gathered together. Your co-operation is absolutely necessary to put this over.

Saturday, Sept. 14. All Day

Arrangements have been made to visit the mine and smelter of the Bunker Hill & Sullivan Mining & Concentrating Company at Kellogg, Idaho, which company will then have in operation its new smelter. This mine is the largest lead-silver producing mine in the world, and the trip will be very instructive and enjoyable, including a boat ride across the beautiful Lake Coeur d'Alene, and returning to Spokane in time to catch trains going both east and west Saturday evening.

As an additional novelty on this trip it is proposed to hold a barbecue. The Bunker Hill & Sullivan Mining & Concentrating Company will extend all the courtesies possible to the convention delegates and their ladies and invites you all to be present.

In commenting upon the program President Osborn of the association has the following to say:

"This I think will be one of the most enjoyable excursions the association has ever held.

"After perusal of the foregoing I think you will all agree that your committee has prepared an excellent program; still, all that the committee can do is to point the way, and it is your duty to do the work as assigned you in the preparation of this program, efficiently and promptly, and so assist in carrying out the convention proceedings.

"It is my belief that in no way can we better show patriotism than by displaying the same spirit that we, as citizens of the United States, displayed in our declaration for national liberty, in making this, our first war convention, greater than all those preceding it. Let us have our business going on as usual."

The Portland Section of N. E. L. A.

The following officers have been elected for the ensuing year to manage the affairs of the Portland Section of the

National Electric Light Association at Portland, Oregon: C. L. Warnicke, chairman; W. H. Lines, vice-chairman; R. J. Davidson, secretary; A. N. Cudworth, treasurer; G. N. Barker, J. C. Henkle, E. D. Searing, executive committee.

San Francisco Section, A. I. E. E.

After an intermission of two months the San Francisco Section of the American Institute of Electrical Engineers held its regular meeting on Thursday evening, May 24, 1917, at Elks' Building. The subject of the evening was "Modern Developments in Street Lighting," by F. C. Piatt of the Pacific Gas & Electric Company. Mr. Piatt has devoted practically all his time to this subject during the past several years and he spoke in an instructive manner and illustrated his talk with interesting models.

San Francisco Engineers Club

The San Francisco Engineers Club held a speakers' meeting on Friday, May 11, 1917, in the club rooms at the Mechanics' Institute Building. The speakers were Ira W. Howarth and H. H. Bliss of the extension division of the University of California. In a very able manner the speakers set forth the wonderfully effective work that is being accomplished among technical men throughout the State of California by means of the extension division of the University. E. O. Shreve of the General Electric Company acted as chairman of the day.

Los Angeles Jovian Electric League

F. M. Sinsabaugh, motor truck distributer, was chairman of the day on May 16th and introduced as the speaker of the day, Walter Wright Alley, engineer for the western department of the Wright-Martin Corporation. His subject was "Airplanes and Their Use in War." A fluent speaker and with a thorough knowledge of his subject, his talk was exceptionally interesting. With the industry still in its infancy, he outlined the recent phenomenal strides in aircraft constructon and stated that the big possibilities presented in this field open up unlimited opportunities to the young man with technical training.

New Mexico Electrical Association

The New Mexico Electrical Association has settled down to hard work through its various committees which have recently been appointed by President M. R. Buchanan. The complete list of officers and committees are as follows:

President, M. R. Buchanan; First Vice-President, J. R. Smith; Second Vice-President, D. W. Morgan; Secretary and Treasurer, Jas. A. Shepard. Executive Committee—M. R. Buchanan, W. P. Southard, C. M. Einhart, K. H. Meyers, W. F. Ritter. Appointive Committees: Membership—M. Nash, chairman; W W. McFarland, A. T. Stack, E. F. Sells, H. K. Bernard, Alex. Hibbard. Rates—W. S. Townsend, chairman; D. W. Morgan, K. H. Myers, Chas. Twogood. Program—C. M. Einhart, chairman; Sydney Ballinger, N. R. Stansel, Alec. Hibbard. Standard Rules—C. M. Einhart, chairman; J. R. Smith, J. J. Cooper, H. J. Wightman. Public Policies—W. P. Southard, chairman; F. P. Wood, J. J. Cooper, D. W. Low. Research—W. O. Vickery, chairman; B. C. Wheatlake, J. L. Brennaman, R. W. Goddard.

Southern California Electrical Contractors & Dealers

A get-together party was given by the Southern California Electrical Contractors and Dealers at Christophers, 741 South Broadway, Friday, May 18th, at 6:30 p. m. R. H. Ballard, general manager Southern California Edison Company, Ira J. Francis, general coast sales agent, John A. Roeblings Sons Company and D. J. Butts, manager Western Electric Company, spoke on subjects of vital interest. The entire affair was enjoyed by all present and closer relations between men of the electrical industry engendered.

The Southern California Electrical Contractors and Dealers announce the removal of their office and the office of the consulting electrical engineer, H. Conger Bowers, from 602 Metropolitan Building to 425 Consolidated Realty Building.

The San Francisco Electrical Development and Jovian League

The program for the meeting of the San Francisco Electrical Development and Jovian League on May 16, 1917, was given over to a consideration of foreign exchange banking methods by Harold Simpson, assistant to the foreign exchange manager of the Crocker National Bank of San Francisco. The speaker in an instructive manner outlined the immense activity ahead for commercial and engineering activity with our foreign neighbors. Stanley V. Walton of the Pacific Gas & Electric Company acted as chairman of the day. E. M. Cutting brought up the subject of electric vehicles and after a discussion by A. H. Halloran of the Journal of Electricity, H. P. Pitts of the Pacific Gas & Electric Company, Robert Sibley of the Journal of Electricity, and Colonel Carter, formerly of the Pacific States Electric Company, the meeting voted to call the attention of the Pacific Coast Section of N. E. L. A. concerning the matter and to express the willingness of the League to back them to the full force of its influence in bringing the electric vehicle and truck into its own.

The program for Wednesday, May 23, 1917, was unusually interesting. Captain Richard Park of the engineer corps of the United States army having been most fittingly introduced by Arthur Halloran, managing editor of the Journal of Electricity, proceeded to entertain his audience with a vivid description of the duties encumbent upon an officer in the engineer officers' corps. A little thrill passed through his audience when he predicted that but fifty per cent of those going to the front in France would probably return to this country. His patriotic remarks were accorded by the audience the sanction and approval they deserved. Stanley Walton of the Pacific Gas & Electric Company, reported excellent progress on the League's effort to assist the Red Cross by a subscription of five hundred membership.

Notes of California Railroad Commission

In the matter of delivery of water by water utilities during the emergency created by war, the commission has ordered as follows:

1. All water utilities are hereby authorized to deliver their surplus water, free or at reduced rates, for additional irrigation during the emergency created by the war.

2. Such water utilities, if deemed by them necessary to protect their legal rights, may require that land holders and irrigators desiring to receive water for the purposes and under the conditions specified in the opinion which precedes this order, shall first sign a stipulation agreeing that they their successors and assigns, will never claim that such delivery of water has amounted to or is evidence of a dedication or that it has in any way prejudiced the legal rights of the water utility.

3. Within thirty days after the delivery of water has been initiated by any water utility to any irrigator under the authority hereby granted, the water utility shall report to the Railroad Commission the name of the irrigator, the amount of water applied for, the land on which the water is to be used, the crop or crops to be planted and the terms and conditions, including the rate, if any, under which water is to be delivered by the water utility.

Notes of the California Water Commission

The following permits have been granted by the Commission:

Natomas Company of San Francisco, 50 cubic feet per second of the Sacramento River in Sacramento County for the irrigation of 6600 acres by means of a pumping plant, a main ditch 5½ miles long and 17 miles of laterals at a cost of $120,000.

Atascadero Mutual Water Company of Atascadero, 7 cubic feet per second of the waters of Salinas River for municipal and irrigation purposes. The water is to be drawn from wells in the bottom of the river by pumping plants and conducted to a reservoir capable of storing 60,000 acre feet. It is intended to water 23,000 acres and the cost of the project is estimated at $750,000.

OF INTEREST TO UTILITIES OF THE WEST

(Centralization of utility effort has long been recognized under commission regulation as the most effective means of creating efficiency and reducing costs of production. Below is an announcement of the authorization by the California Railroad Commission approving the combination of two great hydroelectric companies of Southern California into one of the largest utility units in the United States. It is believed that the net saving will be in the neighborhood of four hundred thousand dollars annually. This new venture under the doctrine of regulated monopoly will be watched with unusual interest by engineers throughout the West. Other announcements of interest to utility men will also be found in this column.—The Editor.)

A Gigantic Merger in Southern California

Authorization for one of the biggest power corporation mergers in the history of the country was given during the week just past when the Railroad Commission gave permission to the Southern California Edison Company of Los Angeles to buy the properties of the Pacific Light and Power Company for a price approximating $27,000,000.

An Effective Publicity Campaign at Portland

The above matter which has appeared in large poster form is the effective work of the officials of the Portland Railway, Light & Power Company. The result has been that a distinct winning over of public sentiment has resulted and a stronger co-operative spirit aroused between the utility and the general public.

The consolidated companies will represent a combined investment of $63,547,522.21. The deal will also give the Edison company control of the Ventura Power Company. The Edison company develops from hydroelectric plants on the Kern and Santa Ana rivers and from steam plants at Los Angeles, Long Beach and Redlands, a total of 119,800 horse-power. The company was originally a consolidation of a dozen or more smaller concerns, and serves sixty cities and towns in Southern California. The Pacific company develops, with its seven hydroelectric plants on the Kern River, Kern County, and Big Creek, Fresno County, and its two steam plants, about 150,000 horsepower. A large part of its business is supplying power to the electric railways of Los Angeles. The Ventura company furnishes electric light and power to about a dozen cities and towns.

By the Commission's order, the Edison company, for the sum of $4,000,000 in cash, $12,029,900 par value of second preferred 5 per cent cumulative nonparticipating stock, is authorized to purchase second preferred stock of the Pacific corporation, $9,660,200; common stock, $10,468,500; first and refunding bonds, $5,000,000; notes and accounts, $1,096,048.41, and preferred stock of the Ventura Power Company, $341,750, and common stock, $704,500.

The Edison company also is authorized to purchase all of the franchises and properties of the Pacific corporation and issue in exchange therefor $11,421,800 par value of its common stock. The properties are being acquired subject to the outstanding bonded indebtedness. The Edison company will acquire all the stock of the Pacific corporation except first preferred, $382,500; second preferred, $318,400, and common, $91,000. Of the Ventura company's stock it will acquire all but preferred, $9030, and common, $1560.

The two concerns state the investment cost of their properties as follows: Edison company, at present, $30,311,328; Pacific, $32,921,392. Adding to the sum of the foregoing $314,800.90, representing the value of the stock of the Ventura company to be acquired, the consolidated companies' total investment is $63,547,522.21.

Richard Sachse, chief engineer of the Commission, estimates the reproduction cost of the combined properties as of October 31, 1916, at $54,018,235.50, and the reproduction cost, less depreciation, at $45,266,386.54.

Commissioner Edgerton, who wrote the decision, says the consolidation is authorized only on the understanding that gradually the relationship between the property value and the capitalization be brought to a more conservative basis. The consolidation, he says, will cut down the capitalization and large savings will be made in operating expenses and greater efficiency will be brought about.

The companies estimate that the annual saving as a result of the merger will be $400,000. The Commission believes that the decrease proportionately in operating expenses will make it possible for the consumers eventually to have lower rates. The combined net earnings of the two larger companies for the calendar year 1916 was $1,500,969.82.

Public Utilities Commission of Idaho

In the matter of the application of the Utah Power & Light Company for a certificate of convenience and necessity in the village of Lewisville, Idaho, the commission granted the request.

In the matter of T. A. Walters, attorney general, complainant, versus Shelley Light & Power Company, Ltd., a corporation, defendant, Utah Power & Light Company, a corporation, intervenor, the commission has ordered that the present and future public convenience and necessity require and will require the construction by the Utah Power & Light Company of a transmission line from its generating station near the city of Idaho Falls to the south of the corporate limits of the village of Shelley in order to furnish electric power to the Utah-Idaho Sugar Company for the operation of its said plant, and also for any other service which may be required on the transmission lines so to be constructed.

LATEST IN EVERYTHING ELECTRICAL

(Wood stave pipe, a product of the West, is rapidly coming into its own as a necessary adjunct to hydroelectric development. Recent installations throughout the Northwest and especially that of the Pacific Gas and Electric Company on its Spaulding development in California emphasize this point. Here is an article by an author who is consulting engineer for the West Coast Lumbermen's Association of Seattle, Wash., that tersely sets forth the salient features of this important method of water conveyance. Its appearance at this time should meet with unusual interest from engineers throughout the West.—The Editor.)

THE USE OF WOOD STAVE PIPE IN HYDROELECTRIC POWER DEVELOPMENT

BY O. P. M. GOSS

A Sixty-three Inch Creosoted Wood Stave Douglas Fir Pipe Line at Wenatchee, Washington

THE mountainous country adjacent to the Pacific Coast contains many valuable power sites, some of which have already been developed, and there are also many yet awaitiing development. These projects usually require long pipe or flume lines to conduct the water to the point chosen for the power station. The lay of the surrounding country will usually determine the type of line to be used.

Wood stave pipe manufactured from Douglas fir staves has proven a very suitable form of pipe for this use. This material can be handled in small units, thereby simplifying transportation through rough and undeveloped country. It also has the great advantage of low first cost. This form of pipe lends itself most readily to the contour of the ground and it has throughout its life the lowest coefficient of friction of practically any form of pipe. The following quotation is taken from U. S. Department of Agriculture Bulletin No. 376:

> "As shown by the table, the relative capacities change for various sizes of pipe and various velocities, but, speaking broadly, it is also shown that the capacity of wood-stave pipe is about 5 per cent less than that of a new cast-iron, 15 per cent more than that of a new riveted steel or 10-year-old cast-iron, and 25 per cent more than that of a 10-year-old riveted steel or 20-year-old cast-iron pipe."

Another very marked advantage in the use of wood pipe at this particular time is that it is so readily available. The wood is the one building material which has failed to increase in price in proportion to the general increase of other materials of construction, therefore, at the present time, there is a far greater difference between the cost for example, of a wood stave pipe line and steel than would have been the case two or three years ago.

Wood stave pipe, like any other material, must be intelligently used. If the pipe is to be built of untreated staves it should be under such conditions as to be practically always in service and should always be under a hydro static head of at least 20 ft. in order that the staves may be kept saturated, thereby preventing decay.

In the construction of such a line it is also very desirable that it be built up above ground, so that the outside portion of the pipe is always subject to the best of air circulation. Untreated pipe which is laid entirely or partly under porous, sandy or gravelly soil or which is empty during a part of the year, is subject to decay. A pipe line buried in a heavy clay soil which keeps the air away from the outer portion of the pipe, should cause no trouble from decay. Regardless of whether an untreated pipe line is laid above or under ground, it should be thoroughly painted on the outside first with a coat of hot coal tar creosote, followed by a coat of hot asphalt or coal tar. These paint coats add materially to the life of the pipe.

Continuous stave pipe which is exposed to the atmosphere is most subject to decay at the joints. The following quotation is taken from U. S. Department of Agriculture Bulletin No. 155 (professional paper).

> "Decay of exposed pipe almost invariably starts at the ends of the staves as a result of leaky joints. Where water leaks out and runs down over the outside of the pipe, favorable conditions are afforded for the growth of algae which usually get a start, then mosses may begin to grow in the soil which collects on such spots and decay spreads to adjoining staves."

Wood is much more subject to attack by fungus on the end grain than on any other surface, which accounts for the development of decay at the end joints.

The following quotations are also taken from U. S. Department of Agriculture Bulletin No. 155:

> "Contrary to the theories generally held 30 years ago, it has been found that the durability of wood pipe is usually dependent on the life of the wood rather than on the life of the bands."
>
> "Where pipes are to be placed in contact with the soil and where the internal pressure is not sufficient to insure complete saturation of the staves, it is probable that their durability may be increased by treating with some preservative."

There is no question at this time but that an untreated wood stave pipe line intelligently built of

A Wood-stave Penstock Pipe for Hydroelectric Development

Douglas fir staves is a good investment. There are many of these lines in service and they are good for from 12 to 25 years. They are, however, subject to local failures due to development of fungus growth which might easily be prevented by suitable preservative treatment of the staves.

The most improved methods of creosoting are particularly suited to the treatment of Douglas fir pipe staves. The staves should be thoroughly kiln dried before treatment and should have from six to ten pounds of oil per cubic foot injected into the stave. The treatment should be done by boiling under a vacuum in such a way as not to injure the strength of the wood. The creosote oil goes in freely at the end of each stave, thereby protecting amply the weakest point found in the stave. Such treatment adds $20 to $23 per thousand feet B.M. to the staves, but does not materially increase the cost of the pipe line in place. This is due to the fact that there are a number of large items which remain constant regardless of the cost of the staves. The steel bands, the excavation, the back filling engineering, overhead, transportation and other costs remain constant regardless of whether or not the staves are creosoted. As a matter of fact, the final cost of the line in place if creosoted will be approximately 20 per cent more than that of an untreated line. There seems no reason to believe but that a thoroughly creosoted wood stave pipe line would last from 25 to 50 years under normal conditions. If conditions are very adverse, a thoroughly creosoted stave pipe line should last from four to six times as long as an untreated line.

One of the largest projects built to date of creosoted staves is that of the Reclamation District in the Wenatchee Valley. This line is approximately 8700 ft. long and is 63 inches inside diameter. It was constructed during the past winter and has just recently been filled with water for the first time. This line when filled was reported to be in excellent condition and is estimated to give a life of from 25 to 50 years.

Similar lines constructed in connection with power development projects would prove thoroughly acceptable to the financing interests, since once installed such lines will have practically no maintenance costs and should outlast steel. The creosote treatment will thoroughly prove its ability to remove practically the only remaining defect, decay, in wood stave pipe.

AN APPRENTICESHIP COURSE OF RAILROADING

To meet the problem of securing trained railroad men and developing them for responsible positions, the Southern Pacific Company has established in San Francisco an "Agency School" under Superintendent of Telegraph King, where an apprenticeship course in railroad work is given and the student at the same time is paid while learning. The plan is proving highly successful. Boys coming from the country and ambitious to "get a start" master the course in from three to four months. Half the time is spent in the class room, and the balance in actual station work. Railroad telegraphy and all the duties of a station agent are taught. Officials of the company lecture to the students on all phases of the transportation question. There is still room in the school for more students. Good paying positions out on the company's lines await the graduates. Over sixty young men have acquired responsible positions in this way since the school has opened.

LATEST FORM OF "SAFETY FIRST" SWITCH

The Crouse-Hinds Company has placed on the market a line of condulets, called the MK series, which is of the highest order of "Safety First" construction. A Condulet of this series consists of a fusible knife switch, inclosed in a cast iron body with hinged cover. A door in this cover furnishes access to the fuse compartment, but the design is such as to prevent this door from being opened when the blades are in the "on" position. Because of this latter fact, the person removing fuses is absolutely protected from receiving an electric shock.

The "Safety First" Switch

The switch is operated by a handle outside the case, and provision is made for locking this handle in either "on" or "off" position by the use of a padlock. While these Condulets are not regularly furnished with a quick-make and quick-break feature, they will be so furnished if purchaser desires. Of course, it is understood that whenever operating conditions require frequent opening and closing of the switch under approximately full load, the life of the arcing parts can be materially lengthened by equipping the Condulet with the quick-make and quick-break attachment. The illustration of type MKC Condulet, given herewith, shows the switch as it appears with the quick-make and quick-break attachment.

MK series Condulet possess another desirable feature in that they are provided with separable hub plates—variously, blank, single hub and two-hub plates. The latter two are made to take standard sizes of conduit from ½ to 3½ inches. This makes it possible to equip the Condulet for almost any arrangement of conduit installation and simplifies the work of installing.

Each type MK series Condulet is made in numerous capacities, ranging from 30-ampere, 2 or 3-pole, 125-volt, to 200-ampere, 500-volt, a.c. 3-pole switches, arranged for N. E. C. fuses.

Besides giving full protection against injury to persons operating the switch, a Condulet of this series is also a "Safety First" fitting in regard to itself. That is, it is dust-proof, weather-proof and, because of its strong construction, both as regards the switch and the case, can stand the hardest and roughest usage. Full details regarding these Condulets are given in Condulet Bulletin No. 1000G. This bulletin will be furnished free to anybody applying for it to the Crouse-Hinds Company, Syracuse, N. Y.

COOPER HEWITT OUTFIT FOR ROTOGRAVURE PRINTING

For use in connection with the making of rotogravure prints, in which all newspapers are greatly interested at the present time, the Cooper Hewitt Electric Company of Hoboken, N. J., is marketing a special outfit. This outfit was built originally for the New York Times. It consists of six 67-inch, 7-ampere, mercury vapor tubes mounted in a stand, the auxiliaries with shifters being mounted at the end of the stand beneath the blower, as shown. The outfit is generally used with a printing frame on each side. Rotogravure prints are made from metal at the rate of about 3500 per hour. The process of making the print consists of using for copy anything that would make a good halftone. From the copy a negative photographic plate is first made. From this a positive is made, which is the

reverse of the negative. This positive is a gelatine film and goes directly to the layout table to be assembled by experts on glass in its proper relation and position with other negatives. When properly assembled, it is brought into contact with a carbon tissue which is a gelatine covered sheet of paper. The carbon tissue is then printed from the positive by means of a strong light, and it is for the purpose of furnishing the required light that this Cooper Hewitt outfit is utilized.

A CAMPAIGN FOR SELLING THE ELECTRICAL IDEA

The window display is one of the best ways of selling the electrical idea. The contractor and dealer scarcely realize the immense importance of this kind of publicity in meeting the trade. Here is a typical display window for selling the electrical idea that was called to the attention of thousands of contractors and dealers last season. Time is now ripe for initiating new and bigger plans, for the coming season. No contractor or dealer can afford to let these days pass without giving time and thought to the important problem of effective window display.

HEAVY DEMAND FOR ELECTRICAL APPLIANCES

Joining forces with the present prosperous condition of the country at large, the educational work of electrical appliance manufacturers and the electrical industry, is bearing a heavy crop of fruit.

For many months, the capacity of electrical appliance manufacturers has been taxed to the utmost and while the managements have been seeking for ways and means to increase the capacity without going beyond a normal growth, purchasing agents have scoured the market for raw material with which to satisfy the demand of the American home.

The fact that housewives the country over are advocating the home electrical, is brought forcibly to our notice by the information which comes to us from the offices of the Hotpoint Electric Heating Company with headquarters at Ontario, California.

Our representative reports from an authorized interview that the Hotpoint Company's business for 1916 came nearly doubling the business for 1915. The information conveyed is to the effect that this company which is reputed to be the largest in the world devoted exclusively to the manufacture of electrically heated appliances, has been carrying for many months, unfilled orders amounting to tens of thousands of appliances and that it has been necessary to parcel out among the trade, goods as rapidly as they could be supplied by working all factories to capacity and pressing into service special facilities that could be commanded.

A NEW JOINT BOX FOR SUBMARINE CABLES

In placing electric cables in underground conduits or in laying them on the bottom of a body of water, frequent joints are necessary. These are apt to be weak spots both electrically and mechanically unless properly made and protected. A new and improved type of joint-box or housing for use on submarine cables has recently been developed and perfected by the Standard Underground Cable Company, and successfully used on submarine cables supplied the Atlantic City Electric Company for the U. S. Ship Canal at Atlantic City, and the Wilmington & Philadelphia Traction Company and Pennsgrove Light, Heat & Power Company for crossing the Delaware River at Wilmington, Del. It was also used in Canada on submarine cables of the Halifax Electric Tramway Company and the City of Ottawa Water Works Department.

NEW BULLETINS

The Carnegie Institution of Washington has just issued a fifty-page pamphlet covering its annual report on terrestrial magnetism.

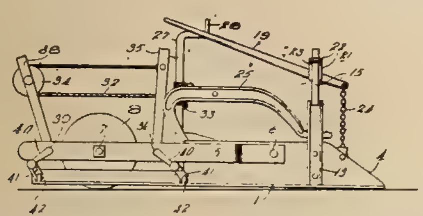
Investigations of the economical duty of water for alfalfa in the Sacramento Valley of California have appeared in Bulletin 3 of the department of engineering, State of California.

WHAT WESTERN INVENTORS ARE DOING

(Since the drift of all utility activity is now "back to the farm," the brief included below on a new ground-leveling machine presents unusual interest to engineers throughout the West as a move in the proper direction for inventive talent. Other interesting patents by Western inventors on apparatus for charging storage batteries, an electrical toy, a new lineman's device and an electric water-heater are also recorded in the following lines.—The Editor.)

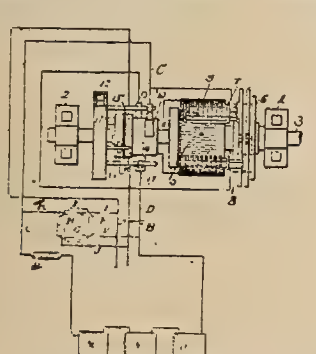
1,223,831. **Ground-Leveling Machine.** Henry J. Reed, Townsend, Mont.

A land-leveling machine, the combination, of a pair of side runners, a scraper blade carried by the runners, a pair of arms connected to the runners, an axle carried by the arms, a roller rotatably mounted upon the axle and positioned rearwardly of the scraper blade, a pair of substantially U-shaped channel irons attached to the runners adjacent their forward ends, a pair of standards slidably and rotatably carried by the channel irons, supporting wheels carried by the standards, pins extending diametrically through the standards adjacent their upper ends, saddles slidably mounted upon the standards and resting upon the pins, levers, pivotally connected to the saddles, flexible members connected to the forward ends of the levers and to the front ends of the runners for raising the front ends of the runners upon downward pivotal movement of the handle ends of the levers.



1,223,471. **Apparatus for Charging Storage Batteries.** Arthur R. Bullock, Cleveland, Ohio, assignor to Henry C. Lee, trustee, Los Angeles, Cal.

A combination with a device for producing a pulsating direct current a circuit for supplying electric current thereto, of a storage battery to be charged by the device, an electrical connection between the battery and the device, a reactance coil in the connection and in series with the battery, and a circuit containing capacity connected between electrically connected sides of the current supply circuit for the first mentioned device and across the circuit of which the battery is a part.

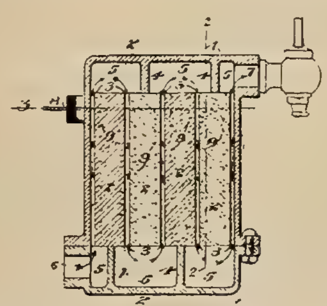


1,223,791. **Lineman's Device.** Van Buren Jackson, Pedro Miguel, Canal Zone, assignor to San Diego Consolidated Gas and Electric Co., San Diego, Cal., a Corporation of California.

A lineman's device for making a connection to a high potential live line wire consisting of a clamp having means of securing a tap wire thereto, the clamp further having a pair of elongated oppositely disposed jaws disposed one above the other with a channel extending longitudinally between the jaws constructed to receive the line wire in a position extending longitudinally in the channel between the jaws when the clamp is moved laterally onto the wire, the outer sides of the jaws being substantially flat and parallel with each other to enable the clamp to be held yieldingly in a holding device engaging the outer sides of the jaws, the lower one of the jaws having screw means attached thereto for securing the line wire in the channel, the screw means having a form to detachably interlock a screw-rotating device.

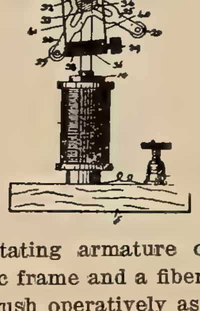
1,224,117. **Electric Water-Heater.** Samuel D. Nesmith, La Jolla, Cal.

An electric water-heater including a casing having a top and a bottom one of which is removable, the top and bottom each having integral inwardly extending partitions, a body of insulating material having a series of flat water passages molded therein, and electrical wires embedded in the body adjacent the sides of the water passages, the body being insertible as a unit in the casing and engaged at its top and bottom with the free ends of the partitions so as to be supported by the partitions of the bottom.



1,223,375. **Electrical Toy.** Gale S. Elliott, Needles, Cal.

An electrical toy, comprising electromagnets, a rotating armature consisting of a metallic frame structure, a means for making and breaking the circuit between the electromagnets and the rotating armature consisting of tongues bent from the metallic frame and a fiber ring arranged within the tongues, and a brush operatively associated therewith.



NEW ELECTRICAL DEVELOPMENTS

(Continued reports from the Northwest relative to the extensive plans for electrification of the Chicago, Milwaukee & Puget Sound to the West of its present efficiently electrified lines over the Rocky Mountains constitute the most interesting news of the past two-week interval from that section, while to the south in Los Angeles interest centers on the twelve million dollar bond issue that is to be voted opon on June 5, 1917, relative to the city's acquiring the present distribution lines serving that municipality. Other items of interest in new electrical developments throughout the West may be gleaned from the following lines.—The Editor.)

FINANCIAL

SAN FRANCISCO, CAL.—Girvin & Miller, Kohl Building, San Francisco, and Torrance, Marshall & Co., 111 East Fourth street, Los Angeles, are now selling series A 6 per cent convertible gold debentures of the San Joaquin Light & Power Corporation, the total issue of which is $1,000,000.

SAN FRANCISCO, CAL.—An intervention suit has been filed in the United States District Court on behalf of Christopher M. Bradley, an owner of the Northern Electric second mortgage bonds. The court is asked to find that the Northern Electric Railway never had legal authority as a railroad to issue the first mortgage bonds, and that the second mortgage bonds are the only existing valid claim upon the property of the company.

OAKLAND, CAL.—Suit for $100,000 against the Western Power Company has been filed by the city of Oakland. The suit was brought in accordance with a resolution voted by the city commissioners. The money is alleged to represent profits due the city upon the percentage plan under which the power company agreed to pay the city 2 per cent on the gross earnings in consideration for the franchise privileges. This money, it is contended, has not been paid for two years.

ILLUMINATION

SAN FRANCISCO, CAL.—The supervisors will receive bids on June 4 for city lighting.

VENTURA, CAL.—The Ojai Valley Men's League has authorized the establishment of 13 street lights.

PORTLAND, ORE.—The city council will not submit the $1,777,000 bond issue for a municipal electric light plant at the election June 4.

CHESAW, WASH.—An electric light plant to supply the business houses, residences and streets of Chesaw is among the 1917 improvements forecasted.

SALINAS, CAL.—The plans and specifications prepared by Consulting Engineer Phillips for the proposed electrolier system, have been presented to the city council.

HANFORD, CAL.—Within sixty days ranches in what is known as Sunset Colony, will be furnished with electric light and power by the San Joaquin Light & Power Company.

VALLEJO, CAL.—The Vallejo Electric Light & Power Company has secured the contract for installing the lighting system in the new Masonic Temple to be built at a cost of $55,200.

BAKERSFIELD, CAL.—Separate sealed bids will be received by the county board of supervisors up to June 5 for the construction and maintenance of an electric lighting system in the Wasco lighting district.

LIVINGSTON, CAL.—A lighting system is to be established in this city. Plans are being made for the formation of a district, President G. H. Winton, Secretary E. G. Adams and Director W. J. Hunt being in charge.

RIVERSIDE, CAL.—The common council received bids up to May 25th for the improvement of Main street between Fourteenth and Tenth street, by the erection on each side of the street of poles, conduits and lamps for lighting purposes.

HALFWAY, ORE.—The streets of Halfway will be lighted with electric lights on or about October 1, according to a contract given to the Idaho Power Company by the town council. The contract runs for 10 years. The cost of building the line into the valley will be $70,000.

YUMA, ARIZ.—The city council has under consideration a proposition for bonding the city to buy the old water and light plant and making necessary additions to bring it up to date. The city engineer has placed a valuation on the old plant at $160,000 and the cost of completing a municipal plant at something over $300,000.

RIVERSIDE, CAL.—At a meeting of the board of public utilities, the electric light department was authorized to build a line to the Highgrove pumping plant of the University of California citrus experiment station, the installation to cost about $1800, to be made provided the department cannot secure power from one of the private companies at a cost not to exceed 1c per kilowatt hour.

TRANSMISSION

ASTORIA, ORE.—The port of Astoria commission has decided to install its own power plant here for operating the machinery at the port elevator and coal bunkers.

TACOMA, WASH.—An ordinance has been passed authorizing the Wheeler Osgood Company to construct and maintain an electric transmission line upon Railroad avenue.

PORTERVILLE, CAL.—Surveys are in progress for the new power plant which the Mt. Whitney Power & Electric Company has to put in the foothills above the Forks on the road to Camp Nelson.

TACOMA, WASH.—A franchise has been granted to the Puget Sound Traction, Light & Power Company for a period of 50 years, to construct and maintain a transmission line along the public highways in Pierce County.

DOUGLAS, ARIZ.—A plan to run a power line from Elephant Butte dam to Kingston to furnish cheap power for mine operators is being considered. The line as planned would run via Chino, Silver City, Kingston and Tyrone, N. M.

LOS ANGELES, CAL.—Whether the city shall issue bonds aggregating approximately $12,000,000 to consummate the proposed power deal with the Pacific Light & Power Corporation and the Southern California Edison Company, will be decided at a general election on June 5th.

SEATTLE, WASH.—The following pole line permits have been granted the Puget Sound Traction, Light & Power Company: On the county road No. 68 from Stevens street south, on West 145th street, on North Trunk Boulevard, on Palatine avenue north of 110th street, and on the Homer Crosby road west of McEachern road.

GOODSPRINGS, NEV.—Capital has been pledged and preliminary work is to be begun soon on the erection of a hydroelectric plant above Bend to generate power for the Goodsprings and Yellow Pine mining district from the Colorado River. It is proposed to deliver the power to places in Arizona, and in Nevada to points as far north as Ely and Pioche.

OLYMPIA, WASH.—The Puget Sound Traction, Light & Power Company, of Tacoma, has made application to the county board of commissioners for a franchise for a transmission line from the Nisqually River to the Log Cabin between Olympia and Tumwater. The hearing of the franchise has been set for June 4.

OROVILLE, CAL.—Engineers for the Great Western Power Company are completing detailed surveys for the dam near the junction of the North Fork and West branch. The specifications for the power plant and for the canal are also being completed, and it is believed that plans will be in

shape within the next six weeks for starting construction work.

CORCORAN, CAL.—The sum of $80,000 is to be expended by the San Joaquin Light & Power Company for a substation to be built 6 miles south of Alpaugh. The new station will supply the rice fields west of Pixley and the Alpaugh and Allensworth districts. The southern end of the big development work of the Tulare Lake Water Company will also be supplied from the new station.

KALISPEL, MONT.—W. B. McDonald of the Northern Idaho & Montana Power Company has applied for a 50-year franchise for light and phone in the city of Ronan. In the event of getting the franchise the Northern Idaho will extend the power line down the east shore of Flathead and on to Ronan. The company has already been granted a permit to run its line along the county road on the east side of the lake.

MARTINEZ, CAL.—The Great Western Power Company will complete in a few weeks its high tension power line from Moraga Valley through Lafayette, Happy Valley and Briones to Crockett to connect with its high tension lines from Antioch and Napa. Steel towers, 80 ft. high, will carry the four cables. The substation on the hills above Crockett will be one of the largest in the state, and will be the central distributing plant for the bay territory.

PLACERVILLE, CAL.—The Western States Gas & Electric Company plans to expend over $1,000,000 in power development in El Dorado County. Surveying crews already are in the field along the South Fork of the American River, where additional power developments will take place. According to present plans a dam will be located on Medley Lake in Desolation Valley; another dam will be at Twin Lakes. A tunnel 2500 ft. long will be constructed under Echo Lake.

REDDING, CAL.—R. C. Starrett, civil engineer for the Pacific Gas & Electric Company and W. A. Cooper, general manager of the Mt. Shasta Power Corporation, which has sold its rights in the Big Bend of the Pit River to the former company, passed through Redding recently on their way to the power plant site in the Big Bend. Starrett will survey some roads for hauling in supplies. The work of driving the tunnel will proceed with a crew at each end. The aggregate length of the tunnel is now a little over a mile. The money is on hand to push the work according to the schedule for the expenditure of the $17,500,000 required for the completion of the power development.

TRANSPORTATION

RIALTO, CAL.—Preliminary work is under way for beginning construction of the new Pacific Electric spur track between Riverside avenue and Date street.

LOS ANGELES, CAL.—An order has been made by the board of supervisors directing the clerk of the board to advertise for sale a franchise for the construction of an electric railway on Highland avenue.

SACRAMENTO, CAL.—That the Western Pacific Railroad Company is prepared to enter into negotiations for the purchase of the Northern Electric Railway Company now in the hands of a reorganization committee, was announced by Charles M. Levey, president of the Western Pacific Company at a meeting of the committee.

SAN FRANCISCO, CAL.—G. K. Weeks was re-elected president of the California Electric Railway Association at the annual meeting held in the Palace Hotel. W. Clayton was re-elected vice-president and G. K. Weeks, Paul Shoup, Jesse W. Lilienthal, W. E. Dunn, W. Clayton, W. R. Alberger and W. V. Hill were elected to the executive board.

KLAMATH FALLS, ORE.—Robert E. Strahord of Portland has arrived in Klamath Falls. It is expected he will start operations soon on the construction of the Klamath Falls Municipal Railway. Klamath Falls is ready now, the city having passed the bond issue, secured the $300,000 and accepted Mr. Strahorn's bid on the contract for construction, which only remains to be signed up by the city and himself.

SALEM, ORE.—Total valuation of the property of the Portland Railway, Light & Power Company useful in public service, and upon which it is entitled to base its rates to the public, is $46,862,972, according to the findings of the Oregon Public Service Commission, made public recently as a conclusion to the biggest valuation case ever handled by the commission. This sum is approximately $14,000,000 less than the valuation for rate making purposes urged by the engineers for the company.

TELEPHONE AND TELEGRAPH

SAUSALITO, CAL.—The trustees have adopted a resolution ordering that a telephone franchise be offered for sale.

LATON, CAL.—The telephone system which was purchased by T. D. Marshall recently from the Laguna Reclamation District, has been connected with the Laton switchboard.

OAKLAND, CAL.—The Pacific Telephone & Telegraph Company has completed plans to build an addition to its structure on Franklin street and will double the capacity of the plant.

BENSON, ARIZ.—It is probable that a new toll center will be established by the Mountain States Telephone & Telegraph Company, either at Dragoon or Johnson in the near future.

VENTURA, CAL.—An ordinance has been adopted by the board of supervisors granting the Oak Ridge Oil Company a telephone franchise upon certain public highways in Ventura County.

FLORENCE, ARIZ.—A crew has been engade stringing telephone wires on the new poles recently put in from the depot to town. A new line is also being strung from Mesa to Florence, and general repair work is in progress throughout the town.

KERMAN, CAL.—The Kerman Telephone Company has announced that work will begin at once on the construction of 50 miles of new telephone lines. Besides the company will make considerable improvements to the switchboard in the exchange building.

YUMA, ARIZ.—The Yuma County Water Users' Association proposes to amend its constitution and by-laws so as to empower the association to tax its members for the purchase and operation of utilities such as telephones, power, light, etc. This move is to pave the way for a proposition to tax every acre of land under the project to raise money to put in an independent telephone system.

IRRIGATION

BRAWLEY, CAL.—Surveying is being conducted at La Balsa, Mexico, for an irrigation project.

PARADISE, CAL.—The Paradise irrigation district directors have let the contract for the distributing system to W. H. Kramer of San Francisco at a figure approximating $160,000. Redwood pipe, instead of steel, will be used.

SACRAMENTO, CAL.—Steps are being taken for the organization of an irrigation district containing about 8000 acres in Hayfork Valley. Water will be taken from Hayfork Creek. $160,000. Redwood pipe, instead of steel, will be used. Engineer, Salem, Oregon.

ANDERSON, CAL.—Twelve carloads of mules and equipment have arrived here, being consigned to the Shattuck, Edington Company, of Los Angeles. This company recently took the contract to complete the major part of the excavation work on the Anderson-Cottonwood irrigation district.

FRESNO, CAL.—The first active step has been taken for the organization of the Kings River Conservation District, the building of the dam at a cost of $9,000,000, and the irrigation of 1,116,000 acres in Fresno, Kings and Tulare Counties. It has been decided to begin immediately the organization of ten or more unit districts.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page preceeding

In This Issue *Merchandising Electrical Energy in the West together with Descriptive Details of Curre Happenings of Interest to Men of the Electrical Industry throughout this vast Empi*

JOURNAL OF ELECTRICITY

VOL. XXXVIII NO. 12 SAN FRANCISCO, JUNE 15, 1917 PER COPY, 25 CENTS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Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXVIII | SAN FRANCISCO, JUNE 15, 1917 | NUMBER 12

The Grandeur of Scenery in Western Washington, showing Mt. Rainier in the Distance

DIKING ELECTRICALLY IN THE NORTHWEST

BY R. M. BOYKIN

(Diking has become a profitable business in many submerged but fertile localities of the West. By scientific reclamation, lands have been increased in value from $2.50 per acre to $175. Such accomplishments as this may be classed as real service to the state, for productive value is thus created which did not exist before. Here is an excellent article on reclamation along the transmission lines of the North Coast Power Company that show the awakening that is going on in western Washington along these lines. The author is electrical engineer for this company and presented this paper before a recent joint meeting of the Portland Sections of N. E. L. A. and A. I. E. E.—The Editor.)

The North Coast Power Company furnishes electrical power to three reclamation projects; one near Gaston, Oregon, with 180 h.p. connected, and two at Kelso, Washington, known as Diking Districts No. 1 and No. 2, with 235 h.p. installed, or a total of 415 h.p., reclaiming approximately 5000 acres of very rich land.

The two reclamation districts near Kelso, Washington, are organized under the diking laws of the State of Washington, and they are in reality municipal corporations.

It will probably be of interest to state how these districts are formed and organized. A petition, containing the names of all the free holders, the acreage to be benefited, the boundary and the general plan of the proposed improvement, is presented to the county commissioners, signed by the owners of a majority of the acreage. This petition must be accompanied by a $500 bond to pay the expenses of the election, in case the voters turn the project down, and the bond is returned if the election is carried.

The county commissioners cause the petition to be published, fix a date for a hearing, and if at the hear-

The Former Appearance of Land now Under Productive Reclamation in Washington

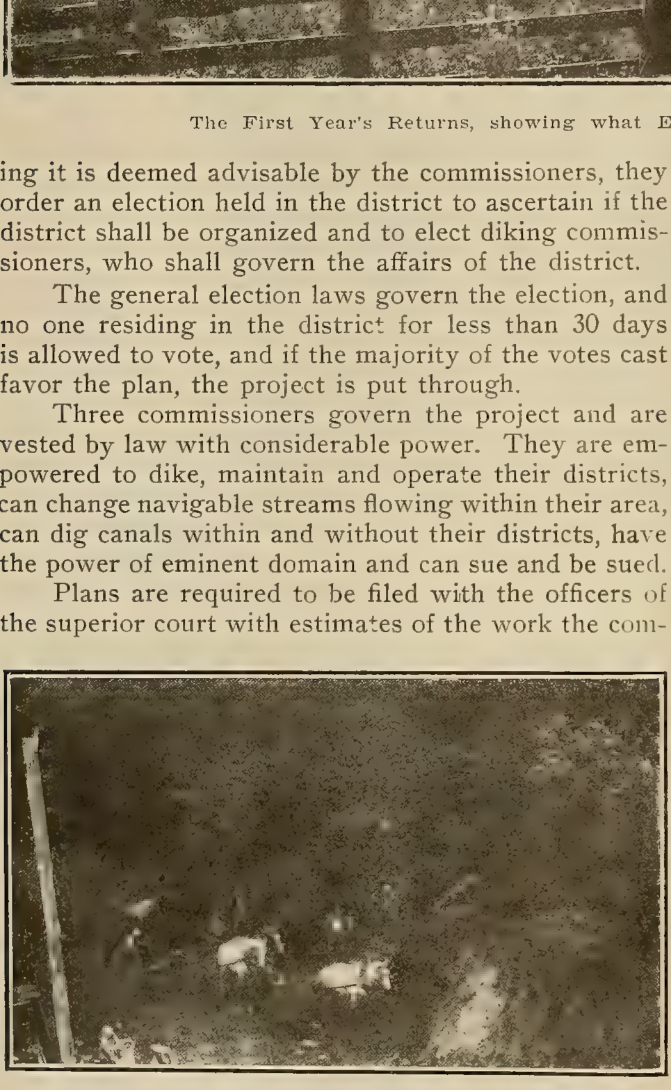
The First Year's Returns, showing what Electrical Energy Can do with Worthless Lands

ing it is deemed advisable by the commissioners, they order an election held in the district to ascertain if the district shall be organized and to elect diking commissioners, who shall govern the affairs of the district.

The general election laws govern the election, and no one residing in the district for less than 30 days is allowed to vote, and if the majority of the votes cast favor the plan, the project is put through.

Three commissioners govern the project and are vested by law with considerable power. They are empowered to dike, maintain and operate their districts, can change navigable streams flowing within their area, can dig canals within and without their districts, have the power of eminent domain and can sue and be sued.

Plans are required to be filed with the officers of the superior court with estimates of the work the commissioners are to undertake; it being also necessary to show the extent of damage and benefit per acre for each property owner of the district.



Installing Transformers in the Jungle of the Reclamation District

The diking commissioners, by resolution, can cause 10 year bonds to be issued to the full estimated cost of the project. The bonds may be given in payment for contract work, but if sold must not be below par and to the highest bidder. The interest rate the bonds carry is fixed by the commissioner and the bond is a promise to pay by Diking District No. so and so, of such and such a county of the State of Washington. The bonds issued for the districts already under reclamation have proved to be in good demand.

The commission fixes the assessment on the property to pay interest and sinking fund on the bonds and for the maintenance of the dike. The county treasurer collects the assessment and acts as disbursement officer on order from the commissioners.

Diking District No. 2 contains 1300 acres of tillable land, lying between the Cowlitz and Cowemen rivers. This district was the first to dike, and when the project was almost completed the commissioners began to investigate power sources. The commissioners, with the exception of one were prejudiced against electric drive, thinking it was too expensive, unreliable and dangerous. All sources of power were investigated, including semi-Diesel engine, but each had its disadvantages, the chief being the high original cost of installation, cost of attendance and maintenance.

A long term electric power contract was finally signed by the commissioners, at the same rates mentioned in the Gaston project, with a $9 per year per h.p. connected minimum charge. The commission furnished the conductors, No. 4 copper, and hardware from the power company's substation in Kelso, one mile and a quarter to the pumping station, which is on the power line of the company.

In the pumping station are two 18 in. centrifugal single stage pumps, one belted to a 50 h.p. and the other directly connected to a 35 h.p. motor. These pumps operate against heads varying from a few inches to 15 ft., depending upon the rainfall and stages of the Columbia River. The maximum demand has been as high as 80 kw. and the first year power cost per acre of agricultural land was $1.45.

The cost of the project was $60,000 or $46 per acre of agricultural land. The dike contains 394,000 cubic yards and was placed in the dike for $.0784 per cubic yard.

Prior to diking the assessed value of the land was $2.50 per acre and it is now $45 to $160 per acre.

Diking District No. 1 was the next district to take advantage of the reclamation law in Cowlitz County. This district has 8600 acres in the water shed and 2750 acres of agricultural land.

These lands are along the Columbia River and

Map of Territory Served by the North Coast Power Company

west of Kelso in the Mount Solo and Coffin district and each day they are covered by tides and in early summer 10 to 13 feet deep with flood waters from the Columbia. It is only during August and September that the lands are dry and then can be used only for grazing.

The diking along the Columbia River is for a 30 ft. stage at Portland, which corresponds to approximately 14 ft. 40 miles below.

This district was bonded for $99,000 and the cost of the completed work was $68,000 or $24.75 per acre for the agricultural lands.

This district presented a more difficult problem for electrification than either of the two described before. The location of the belted, 24 in. centrifugal pumps, requiring 150 h.p. necessitated 6.63 miles of line. The line had to be built partly along a freshly constructed, soft, muddy dike and through the marsh tide lands.

The expense of construction and consequently heavy investment and the probability of not sufficiently long pumping periods to produce the revenue to warrant the investment, made us hesitate for some time before soliciting the business.

The run-off, rainfall, evaporation, percolation and tides had to be reckoned with to determine the amount of pumping that would be required. Using available data, it was thought $2500 to $3000 per year would be the gross revenue, which was sufficient to warrant the building to the load. As the diking progressed, however, the owners of adjacent marsh lands became much interested in reclamation and before the end of 1917 we confidently expect about 8000 acres will be placed under dike, that will be supplied with power from the same line. The calculated revenue was 59 per cent overestimated, due to a rather unexpected quantity of the drainage being taken out through automatically operated tide gates. However, with the added acreage under dike, the revenue to be derived will make the line a profitable investment.

Upon deciding to solicit the business of this district, great difficulty was encountered in obtaining it, due to the energetic work of the Semi-Diesel engine salesmen and to the lack of knowledge of the commission (composed chiefly of Finns) on electrical matters. The terms in the contract were not understood and they demurred against securing right-of-way for the line and advancing a portion of the building capital, which was to be returned in monthly payments of 30 per cent of the monthly bills, but not to apply upon the minimum charge.

Fortune smiled upon us in the survey which was done when the country was frozen early in 1916, otherwise the cost would have been high, on account of the soft boggy ground. The cost of the survey and detailed maps and plans of the line was $28.50 per mile. When the preliminary estimate of the cost of building the line was made, it was decided to use No. 6 M.H.B. copper, the price then being 20c per lb. By the time orders were to be placed for the material, copper had advanced to 27c and No. 6 could not be had.

The pole spacing is now 300 ft. with one-fourth inch, 7 strand, No. 14 double galvanized, low strength steel for conductors, and No. 9 B.B. telephone wire for ties. The line is designed to carry 225 kw. with 5 per cent drop at 22,500 volts, but later the voltage will be doubled and the line extended some 8 miles for another load of somewhat the same character, down the river.


An Outdoor Transformer Station with Dikes in the Distance

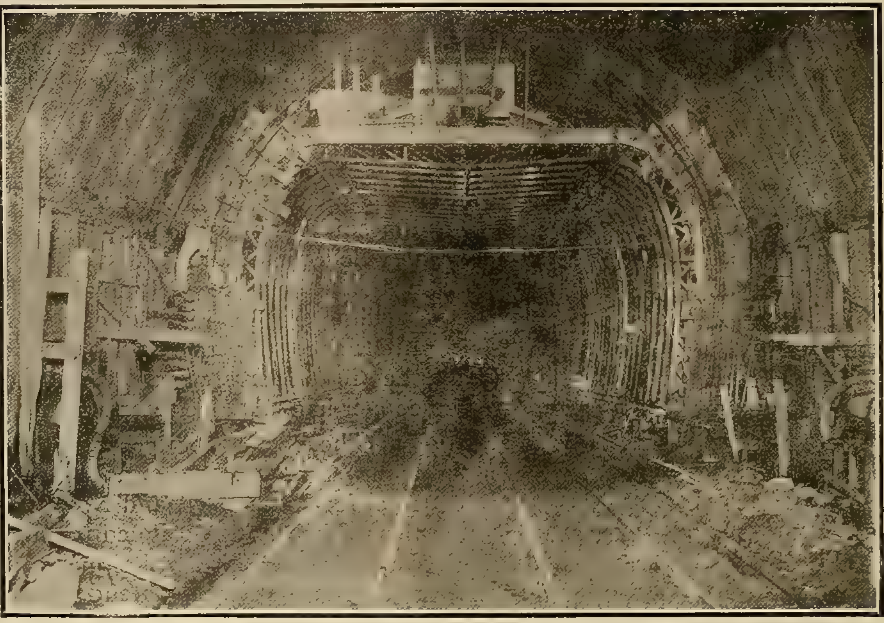
The highest load on this steel conductor line has been 135 kw. but will be 270 kw. when the added acreage is enclosed by the dike, at which time tests will be made to determine the voltage drops and power lost. The conductors have 48 in. of sag at 70 degrees temperature, giving ample factor of safety for the climatic conditions on the Columbia River so near the mouth.

CONSTRUCTION FEATURES OF TWIN PEAKS TUNNEL

BY R. C. HACKLEY

(Thirty-seven hundred feet is a new record for shooting concrete through a cement gun. Below is a remarkable account of how concrete has been efficiently handled through such a record breaking distance in which velocities of a mile a minute have been experienced. The Twin Peaks Tunnel for the municipal railways in San Francisco has other unusually interesting features in its construction, especially in the manner in which the giant steel forms for concreting have been utilized. The author is the superintendent and engineer for the construction company by whom this work is being performed.—The editor.)

The Twin Peaks Tunnel, now nearing completion in San Francisco, is the largest municipally owned electric street railway tunnel in the country, being twelve thousand feet in length, and twenty-five feet in width, allowing ample room for two tracks.



Interior View of Twin Peaks Tunnel, looking West

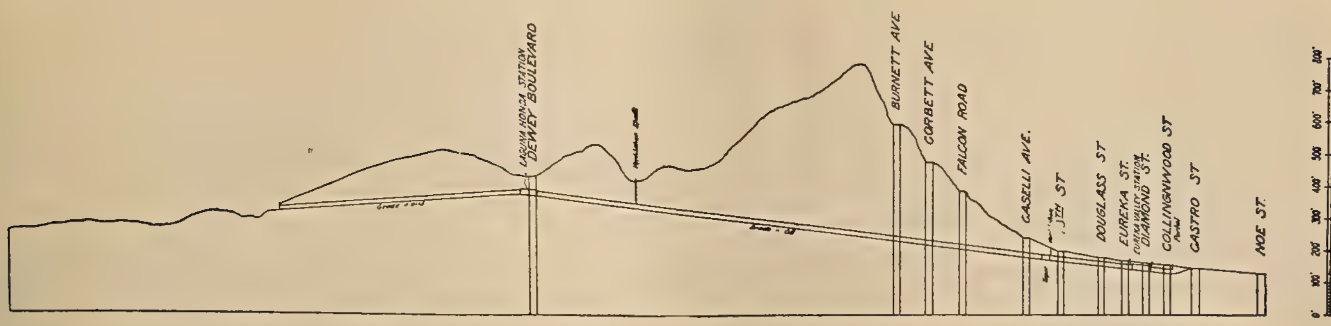
Here are shown the giant steel forms in place, the pumps for handling the water encountered, the baffle above for meeting cement gun velocities of a mile a minute and in the center the traveling frame work for manipulating the steel forms upon tracks at the extreme sides of the tunnel. This tunnel, twelve thousand feet in length, is the largest municipally owned electric street railway tunnel in the United States. On the extreme sides may be seen the conduits for the electrification of the railway workings which are soon to be installed.

In section, the tunnel is horseshoe shaped with a reinforced concrete slab or ceiling across the tunnel four and one-half feet below the arch. This space is provided for the ventilation of the tunnel by forced draft. During the construction this space has been used advantageously for the purpose of ventilation, carrying of temporary wiring, and for the transportation of concrete.

Two features of the construction work which are out of the ordinary, and which have worked out very successfully, have been the use of a specially designed steel concrete form, and the use of compressed air for the mixing and transporting of all of the concrete throughout the tunnel proper, amounting to approximately seventy-five thousand cubic yards.

The placing of the concrete lining follows as closely as is practical the excavation and is carried along in three distinct operations. First, eighty feet of steel forms are set for the footings of the side walls of the tunnel, and the concrete poured by means of chutes from a hopper hereafter described. Then after this concrete has set sufficiently or for about forty-eight hours, the forms are removed and the steel form for the side walls and ceiling slab are moved ahead in ten foot sections and secured to the concrete footings by bolts previously set in the soft concrete. The form sections which weigh seven and one-half tons each are carried on a timber traveler running on rails which are clear of the double tracks used for handling the muck from the heading. As the traveler is built so

Plan, showing Interconnection of Districts Served by Tunnel



Profile of Tunnel, showing Various Stations

that the dirt cars from the heading can pass under it, all construction operations can be carried on at the same time without interfering with one another. The traveler is pulled ahead on its track by means of a hoisting engine, operated by air, mounted on the traveler, pulling on a line lead out ahead. In this manner the eight forms or eighty feet comprising the set are moved ahead in about ten hours by a crew of four men. The forms are so designed that one can be passed through another if so desired by lowering it down and swinging the sides in. After the concrete sides and slab are poured the eighty feet of arch is framed and poured. In this manner eighty feet of concrete lining is poured every week.

The concreting is carried on from both ends of the tunnel, the air for all operations being compressed at one central power station. This plant consists of two seven hundred and fifty cubic feet and one eleven hundred feet two-stage compressors run by two 100 h.p. motors, and one 150 h.p. respectively. The air is compressed to about 100 pounds, and is carried over a hill to the east end, a distance of seven thousand feet, in a six-inch pipe, where it enters a receiver. From this receiver, the air is lead in a four-inch pipe to the mixer, located under ground, which is a steel drum about thirty-six inches in diameter and five feet long standing on end with a conical bottom terminating in a specially constructed eight-inch elbow, to which is connected the eight-inch discharge pipe. The mixer is charged from material bunkers above, the aggregate being measured in a charging hopper directly over the mixer. When the dry batch is ready in the hopper a door in the top of the receiver or mixer is opened, the charge dropping in, and at the same time a measured quantity of water is also run in. The charging door is now closed by a piston operated by air, and at the same time a valve is opened, admitting compressed air to enter at the back of the elbow at the bottom of the mixer through a two-inch pipe. Immediately on opening the lower valve, another vale is opened allowing the air to enter at the top of the receiver or mixer and putting a pressure directly behind the batch and thus forcing it out at the bottom where the lower jet keeps it moving. The batch of concrete will usually travel through the eight-inch pipe in a mass, at the rate of about a mile a minute and to receive this blow, a steel hopper is secured to the tunnel timber at the discharge end of the pipe, the concrete striking against heavy renewable steel plates. The speed of operation of the gun depends upon the length of pipe line and will vary from seventy batches per hour at three hundred feet, to thirty batches at the present distance, which is the record for the pneumatic gun, being 3700 ft. The efficiency of the gun is dependent on the operator and the volume and pressure of air available. A careless operator may cause a plug in the pipe line, taking hours to clear. The concrete from the east end being forced up a 3 per cent grade is necessarily raised a height of 111 feet, and uses a large quantity of air. From the steel box or hopper at the end of the pipe the concrete is carried to place in the footing walls and slab by gravity and worked into place as ordinary concrete. In the case of the arch which is eighteen to twenty-two inches in thickness the concrete is shot directly into place, lengths of pipe being removed from the end of the line as the space is filled with concrete.

At the present time, there remains about three hundred feet of the rock core to be taken out, and seven hundred feet of concrete lining to be completed. By the first of July, the tunnel will be entirely completed.

The entire construction work has been handled by the contracting firm of R. C. Storrie & Company under the supervision of M. M. O'Shaughnessy, city engineer of San Francisco.

KEEP THE PUMPS WORKING

Owners of irrigation pumping-plants throughout California are in a position to add greatly to the production of food supplies for the Allies by selling water to their neighbors at a reasonable cost during such times as their pumps are not needed for their own irrigation.

This is the conclusion of the College of Agriculture of the University of California, after a thorough survey of the irrigation resources of the state.

Few irrigation pumping-plants in California are now run continuously. A very large majority of them are not operated at night.

An emergency law just passed by the legislature permits individuals to dispose of water without becoming public utilities and without incurring an obligation to continue to supply water in the future.

The Committee on Resources and Food Supply of the State Council of Defense urges owners of land near pumping plants to make every effort to obtain water from such plants when they are not needed by their owners. Also, it urges owners of such pumping plants, to make the charges to their neighbors as low as possible, in order to stimulate the continuous use of pumping plants throughout the irrigation season during the war period.

DIESEL ENGINE OPERATION

(Here is an excellent discussion of how some of the serious troubles in Diesel engine operation may be done away with. The deposit of scale in the water jacket and the accomplishment of effective lubrication are factors that have much to do with efficient operation of the Diesel Engine. These factors are among several important questions discussed in the following article. This article has been written for the Journal of Electricity by one of the best known engineers in the West, but his name is withheld by personal request. It is believed that its contents will receive an unusual welcome by all interested in increasing the efficiency of the Diesel Engine.—The Editor.)

Engineers who have recently given careful consideration to Diesel engines are convinced that with proper precautions and with a thorough understanding of operating conditions the Diesel engine, as manufactured in the United States, is unequalled for certain classes of service, but nevertheless operating troubles seem to increase rather than decrease with the number of installations, and many engineers have been discouraged from adopting them because of the apparent failure of some installations.

A few suggestions as to how some of the more common but serious troubles may be obviated are offered:

Too frequently does the user overlook the fact that the maximum horsepower developed by the Diesel engine depends not upon the amount of fuel oil introduced into the cylinder, but upon the amount of oxygen present to burn the oil.

The maximum horsepower output of an engine is proportional to the displacement air capacity of the cylinders. The lower density of the air and higher altitude is responsible for the decrease in horsepower output of Diesel engines as compared with the sea level rating. At sea level an engine should be rated on a basis of cylinder capacity of air per brake horsepower per minute. There is a tendency among American manufacturers to apparently over-rate their engines. This is shown by the cylinder capacity per brake horsepower per minute of different makers, which varies from 2.92 to 3.54. It is the air capacity and not the fuel consumption that determines the maximum continuous horsepower output of a Diesel engine.

Another point almost always ignored is the decreasing output and hazardous condition of operation resulting from a deposit of scale in the water jacket. Manufacturers recommend that their engines be operated with cooling water issuing at a temperature not to exceed 130° F., and provide thermometers for determining the temperature of the cooling water issuing from the engine. As the outside or jacket surface of a cylinder liner is at a much higher temperature than 130°, this temperature only indicates the average temperature of the water in the cooling jacket, and it is obvious that the water in immediate contact with the cylinder liner is at a very much higher temperature. Most waters, under these conditions, deposit a scale which gradually becomes thicker until it forms a fairly good insulating coating on the surfaces, which require the greatest cooling. Eventually the condition is arrived at where insufficient cooling is obtained although the thermometer may show and often does a gradual reduction of temperature of cooling water and cylinder and valve troubles develop. These difficulties are usually preceded by excessive carbonization, inability of the engine to deliver full load, and frequenly a seizing of the piston in the cylinder and the breaking of major parts of the engine. It usually takes some months for this condition to develop, and the manufacturer has been paid in full and departed joyfully, leaving the trouble that follows to the purchaser and his operating engineer.

This trouble is avoided by some operators who at intervals of two or three months dissolve the scale by the introduction of a weak solution of hydrochloric acid, followed by a thorough cleaning and washing of the internal surfaces of the water jacket. This treatment if properly used at regular intervals, depending upon the amount of scale forming qualities of the cooling water, will usually avoid troubles resulting from over-heating due to the cooling water not being able to properly perform its function of cooling the cylinder walls. Another method, however, has been used in a recently installed plant, in which distilled circulating water is used for cooling the cylinder jackets, the distilled water being pumped through pipe coils and forming with an expansion chamber practically a closed system, requiring little or no additions or make-up water. The pipe coils are located outside of the building and the distilled water circulating within them is cooled by dripping over them a sufficient quantity of cold water, regardless of its clearness or scale forming qualities.

Unsatisfactory and defective lubrication is responsible for many of the Diesel engine operating troubles. In many makes of engines the lubrication of the wrist pin is particularly inefficient, requiring the use of a large quantity of oil, of which but a small quantity ever reaches the bearing surfaces of the wrist pin, the balance finding its way into the lubrication of the piston. The excess in combination with excessive heat conditions due either to overload or scale eventually becomes carbonized and fills the grooves of the cylinder rings making them ineffective. An excess of lubricating oil between the piston and the cylinder is sure to carbonize, requiring the frequent pulling of pistons and cleaning of ring grooves and rings. Proper and efficient lubrication equipment that will put the required quantity of oil where it is needed instead of using a flood of oil in the hope that a small quantity will find its way into a bearing is to be greatly desired, particularly for the wrist pins of Diesel engines.

A new Pacific Coast construction record is claimed for the huge Southern Pacific building which is already transforming the appearance of lower Market street. Ground was broken for this—the largest office structure in the West—September 1, 1916. With the first of May, 1917, the structure was approximately seventy per cent completed, with every prospect that the general contractors will turn over the building for occupancy one year after the first shovelful of dirt was removed.

CHEMICAL WEALTH IN LAKE WATERS

BY J. W. BECKMAN

The most noted example of an inland sea in the United States containing in its waters chemicals of value is the Great Salt Lake in Utah. This lake contains practically the same salts as occur in the waters of the ocean, only at a much higher degree of concentration.

Further west, in the states of Oregon and California, there are a number of lakes of various sizes, containing waters in some cases heavily charged with valuable salts readily recoverable. Especially noticeable among these are the Searles Lake, in the lower part of California, Owens Lake and Mono Lake, in the eastern part of the State of California. These lake waters contain considerable quantities of soda ash, which is used in the households, as well as industries. The borax content of these waters is also considerable and offers a readily available source for this salt. Some potash is recovered, and a great quantity of common table salt is also obtainable from these lake waters.

The origin of these salts is in many cases hard to trace. In some cases they are undoubtedly due to an arm of the ocean becoming land-locked and the water gradually evaporating, producing concentrated salt solutions; but since in some there are present salts which do not occur in the ocean waters, it has to be assumed that these salts have been leached out from the surroundings—in most cases high mountain ranges.

The war, with its accompanying high prices for chemicals, has brought these lake waters to the attention of various interests; and plants are already established, and are being established, on the edges of these lakes, where, through solar evaporation, as well as artificially, various salts are separated from each other and obtained in marketable condition.

A remarkable incident with those waters is the fact that they seem to be continuously fed from subterranean sources, since they maintain practically a uniform concentration of salt solutions. The natural evaporation, which takes place from the surface of the lakes during the hot, dry, summer season, does not seem to materially vary the salt percentage in the lake waters.

The waters of these lakes belong to the people of the United States and whoever places a pipe line to the edge of the water and pumps the water out of them has the right to the salt contents of same, without further cost.

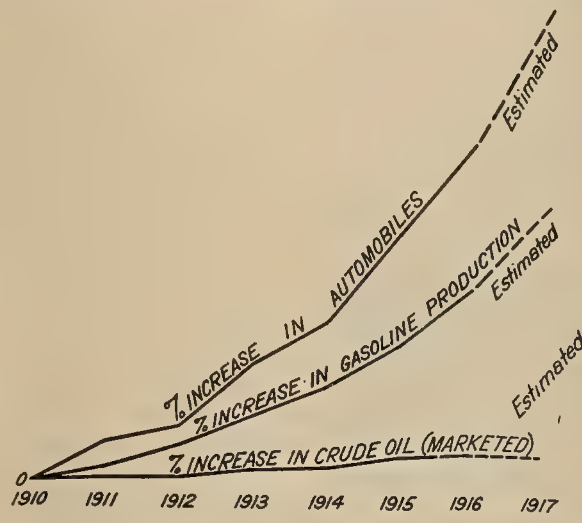
GLASSES FOR PROTECTING THE EYES FROM INJURIOUS RADIATIONS

A new publication of the Bureau of Standards (Technologic Paper No. 93) entitled "Glasses for Protecting the Eyes from Injurious Radiations," has made its appearance and will be found extremely useful.

The object of the present investigation is to give the protective characteristics of representative groups of glasses which are available for protecting the eye from (1) the ultra-violet, (2) the visible, and (3) the infra-red rays. The paper gives the characteristics of black, amber, green, greenish-yellow and red glasses which are efficient in protecting the eye from the ultra-violet rays. Similarly the characteristics of deep black, yellowish-green, sage green, gold plated and bluish-green glasses are described, which are efficient in protecting the eye from the infra-red rays.

A GRAPHIC CHART DETAILING THE FUEL OIL SITUATION

In a recent address on the petroleum and gasoline situation delivered by Van. H. Manning, Director of the U. S. Bureau of Mines before the editorial conference of the business publishers association in Washington, D. C., the chart reproduced herewith was exhibited.



The graphic chart shows the percentage of increase in the number of automobiles and the percentage of increase in the production of gasoline and crude petroleum since the year 1910. The lack of parallelism of these curves indicates what may be expected in the future, especially in the motor fuel market and illustrates the general situation perhaps better than any mass of figures that may be compiled.

MEASURING THE VOLUME OF CALIFORNIA STREAMS

The study of the volume of flow of the principal rivers of the United States is one of the important activities of the United States Geological Survey, Department of the Interior. A report that will be useful to engineers and others interested in the utilization of the streams tributary to the Pacific Ocean in California has just been issued by the United States Geological Survey as Water-Supply Paper 361, which is one of a series of twelve reports presenting the reults of measurements of flow of the streams of the United States made during 1913.

The German howitzers which so speedily demolished the Belgian and French fortresses are reliably reported to have been made with linings of molybdenum steel, which not only withstands better than any other steel the enormous stresses of modern high explosives, but owing to its high melting point is less affected by the heat of the gases released and thus provides an ordinance far longer lived than that made of any other steel. Here is another opportunity for investigation of Western resources and possible electrical applications.

PHOTOGRAPHY FOR THE ENGINEER

(Interior photography, especially where machinery is involved, is a subject of much confusion to the engineer, who is often anxious to preserve in his files a view of an interesting installation visited by himself. Here are terse rules that should be of immense value for handy reference, when such views are desired. The author is on the engineering staff of the Pacific Gas and Electric Company in San Francisco. In our next issue, a discussion of night photography will conclude this series of four articles, which have proved so helpful to engineers in their use of the camera.—The Editor.)

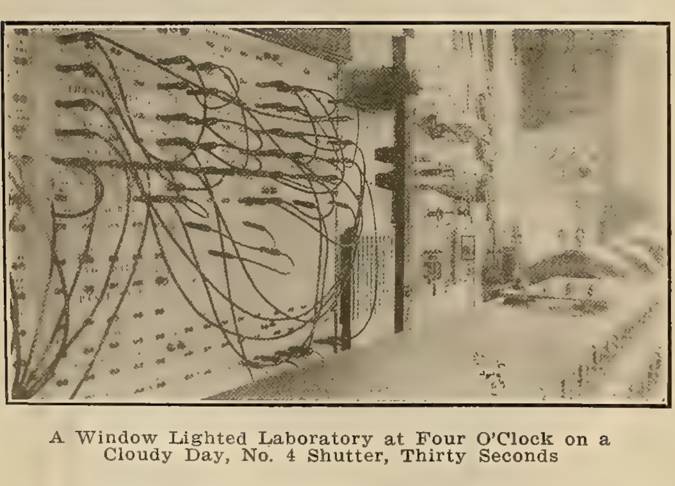
INTERIOR PHOTOGRAPHY

BY C. B. MERRICK

An Interior View of a Power Plant, Skylighted, Bright Outside, No. 16 Shutter, Eight Seconds

SPECIAL subjects often require special exposures to produce correct results. The engineer is called upon to take interior views of construction or repair work and for that reason these will be dwelt upon in detail. Here the variation in intensity of illumination is especially great. Due to lack of reflected light and the nearness of the object, long exposures are required.

Medium colored walls and surroundings will lengthen an exposure to double that necessary where white walls predominate, while dark walls require four times as much time. A skylighted room will require less time than one with windows, due to the reflected light of the sky, while a room with only one window requires approximately twice the exposure where more windows are at hand.



A Window Lighted Laboratory at Four O'Clock on a Cloudy Day, No. 4 Shutter, Thirty Seconds

If important to obtain the picture without delay, a good rule to follow is to make one exposure at the estimated value and then take two others, giving respectively 1/3 and 3 times this value.

Rules for Inside Work

1. Main light—for relief.
2. Auxiliary light—to prevent lack of detail in shadows.
3. Curtain windows in field of view to guard against over-exposure.
4. Avoid reflections in glass or shiny surfaces.

Suggestions for General Use

1. Take contrasty views on cloudy days.
2. Intensify flat views by use of shadows.
3. Shadows are long, early and late.
4. Take snow scenes toward the sun, but shield lens from direct light.
5. Don't take pictures when hazy or dusty; and keep the lens clean.
6. Sunshine on leaves makes a spotty background.
7. Focus accurately for close views.
8. Carry camera set at stop 16, 1/25 sec., as this is value most often used.

"The Builder" at the San Francisco Exposition Intensified by Shadow, No. 30 Shutter, One Twenty-fifth Second

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WAR LOANS

Great Britain's estimated wealth is $85,000,000,000; she has made three great loans since the commencement of the war, aggregating $10,000,000,000. Her last loan was for $487,000,000, which was the greatest single loan ever floated in the history of the world. It was taken up in 30 days, 5,289,000 individuals subscribing to the loan. One person in every 11 inhabitants of the United Kingdom subscribed to this loan, and the average subscription was $950, though a great many subscribers took only £1 or about $5. The great number of subscribers to this loan is pointed out as evidence of the patriotism of the British people. Germany's wealth is estimated at $80,000,000,000. Germany has put out five loans since the commencement of the war, aggregating $11,750,000,000. In Germany's latest loan 1 person in 13 of the population is reported to have subscribed, and the average amount taken by each subscriber was $700.

Taking into consideration these figures, the $5,000,000,000 loan of the United States with an estimated wealth of $220,000,000,000 and a population of over 100,000,000 seems almost small. With a wealth nearly three times as great as that of Great Britain it is trying to borrow less than one-half of what Great Britain has borrowed. With a population one and one-half times as large as that of Germany our loan is much less than half of the amount that Germany has borrowed.

America's Liberty Loan is less than one-sixth of the bank deposits in our country. An ordinary borrower does not think he is ruining himself when he borrows 40 per cent of the value of his property. The United States is borrowing less than 3 per cent of its wealth.

STANDARDIZATION OF TRANSFORMERS

BY S. J. LISBERGER

(All engineers engaged in the design and operation of distribution systems know well the troubles encountered in endeavoring to purchase and operate transformers for different ratios for approximately the same voltage. There existed twelve different classes where normally there should have been but three and this refers to only one division of the transformer supply and not to the entire line so that after all there existed very many classes where there should have been but few. Here is a report on transformer standardization of vital interest to engineers throughout the West. The writer is a member of the Committee on Electrical Apparatus, N. E. L. A., and as such was appointed chairman of the Western Sub-Section of the National Committee to deal particularly with the subject of the standardization of transformers. It is to be particularly noted that this report is not a verbatim copy of the National report but is rather a paraphrased edition by the writer to cover all essentials for Pacific Coast conditions.—The Editor.)

For several years the Apparatus Committee of the National Electric Light Association has been endeavoring to standardize the sizes and voltages of the several lines of transformers.

At the beginning of this work, in one line of distribution transformers alone, twelve separate and distinct ratings existed, where there should have been normally but three.

This condition did not tend to bring about a reduction in transformer costs, nor an improvement in stock conditions.

It was in the hope of remedying these conditions that the apparatus committee undertook the work of bringing about a common standard.

In order that there might be representation from the West the apparatus committee appointed in 1916 a Western sub-committee to deal with this problem of standardization and following a meeting of the Western sub-committee, together with the power companies in this section, a representative was sent east to attend the meeting of the apparatus committee in February.

At this meeting the whole problem was very frankly and thoroughly discussed and as a result the following standards have been prepared after carefully analyzing the requirements of the large majority of the transformer users.

It should be borne in mind that there are many systems whose transformer requirements will not conform to the standards listed and it is not the intention that these recommendations shall limit the use of any special transformers, but the specifications herein are the ideal towards which to work in designing new systems or in making additions or changes in existing systems.

Material economies will result to users of this class of apparatus if these standards are generally adopted, deliveries will be improved and local stock conditions will be much better than under existing conditions.

Transformers are classified as power transformers Class "A," used as step up units in generating stations which includes sizes **above 200 k.v.a.** In the second class are substation transformers Class "B" which includes primarily those transformers in sizes above 200 k.v.a. These are used to step down from the transmission voltage to a distribution voltage; and also includes transformers in sizes **above 200 k.v.a.** used to step down from either the transmission or distribution voltage to service voltage suitable for supplying various current consuming devices.

As a third class, we have distribution transformers Class "C." This class includes primarily those transformers in sizes of **200 k.v.a. and below** which are used to step down from the distribution voltage to a service voltage suitable for supplying various current consuming devices; and also includes transformers in sizes 200 k.v.a. and below used to step down from the transmission voltage to a service voltage or even from the transmission voltage to a distribution voltage.

Specific Standards for Power Transformers—Classes "A" and "B"

Standard types—Oil immersed—self-cooled; oil immersed—water cooled; air blast.

Standard frequencies—60 cycles per second; 25 cycles per second.

Standard k.v.a. sizes.

The trend of practice has shown that in the adoption of transformer sizes it is best to consider the three-phase or bank capacity of the installation rather than the capacity of single-phase units. Therefore, in this list of standards the size of the three-phase and single-phase units comprising the bank are on this basis.

In selecting the size of a bank of transformers the present connected load, the estimated additional load and the load factor are usually given proper consideration. As some of these factors can at best be only approximated it is strongly recommended that the standards listed be followed.

It is believed that material benefit will accrue to operating companies if logical standard sizes are adopted, and it is hoped that all operating companies will encourage the manufacture in line with the standards.

Standard k.v.a. Sizes—Power Transformers

Oil Immersed Self Cooled		Oil Immersed Water Cooled and Air Blast	
Single Phase	Three Phase	Single Phase	Three Phase
...	300	...	...
...	450	...	...
...	600	...	...
250	750	...	750
333	1000	...	1000
400	1200	...	1200
500	1500	500	1500
667	2000	667	2000
833	2500	833	2500
1000	3000	1000	3000
1250	3750	1250	3750
1667	5000	1667	5000
2000	6000	2000	6000
2500	7500	2500	7500
3333	10000	3333	10000
5000	15000	5000	15000

Standard High Voltage.—The following nominal open circuit high voltage values are recommended as a standard for power transformers.

Single-phase transformers for 3-phase operation at these voltages will be rated in accordance with the connection used.

For example: 6650/11500 "Y" if for "Y" connection, or 11500 if for delta connection on 11500 volt line.

Standard High Voltages—Power Transformers—Classes A & B

Oil Immersed Self Cooled Also Oil Immersed Water Cooled	Air Blast
2300	2300
6900	6900
11500	11500
13800	13800
16500	16500
22000	22000
33000	.....
44000	.....
66000	.....
88000	.....
110000	.....
150000	.....

It is recommended that the application of air blast transformers be confined to systems where the line voltage does not exceed 25000.

Standard Low Voltage.—230/460 volt for nominal 220 and 440 volt motor service.

575 for nominal 550 volt motor service.

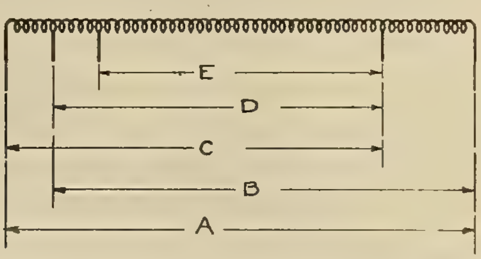
2300/4000 "Y" for nominal 2300 volts single-phase and 3-phase delta; also for 4000 volt, 3-phase "Y" either 3 or 4 wire.

Note.—When voltages in excess of 2300/4000 "Y" are required it is recommended that they agree with the standard high voltages listed above.

Series multiple connection on low voltage side of power transformers involving more than two voltages should be avoided.

Standard Taps.—Power transformers used in both generating and substations may in many cases require taps to compensate for transformer and line drop.

As transformers with taps are more difficult to construct than those without due largely to the problems connected with insulating the tap connections, it is recommended that purchasers of transformers limit the number of taps to the lowest possible minimum,



Method of Obtaining Four 2½ Per Cent Voltage Steps
A = 100%. B = 97½%. C = 95%. D = 92½%. E = 90%.

obtaining thereby transformers with safer operating characteristics and at lower cost. When taps on power transformers are necessary it is recommended that they be limited to two 5 per cent steps, or at the most four 2½ per cent voltage steps below normal rated voltage.

Specific Standards for Distribution Transformers, Class "C"

Inasmuch as this class of transformers covers those of 200 k.v.a and below the oil immersed self cooled type is standard for this class.

Standard Frequencies.—60 cycles per second; 25 cycles per second.

Standard k.v.a. Sizes.—In the following table are listed the sizes of single-phase transformers which have been adopted as standard.

Standard High and Low Voltages.—In preference to manufacturing two lines of transformers heretofore

Standard Single-Phase Sizes for the Different Voltage Lines of Distribution Transformers

k.v.a.	Sizes							
1	2300		11500*	.....	.....	.....	.....	.....
1.5	....	6900	.....	.....	.....	.....	.....	.....
2	2300	....	.....	.....	.....	.....	.....	.....
2.5	....	....	11500	13800	.....	.....	.....	.....
3	2300	6900	.....	.....	.....	.....	.....	.....
5	2300	6900	11500	13800	16500	22000	.....	.....
7.5	2300	6900	.....	.....	.....	.....	.....	.....
10	2300	6900	11500	13800	16500	22000	33000	.....
15	2300	6900	11500	13800	16500	22000	33000	44000
25	2300	6900	11500	13800	16500	22000	33000	44000
37.5	2300	6900	11500	13800	16500	22000	33000	44000
50	2300	6900	11500	13800	16500	22000	33000	44000
75	2300	6900	11500	13800	16500	22000	33000	44000
100	2300	6900	11500	13800	16500	22000	33000	44000
125	2300	6900	11500	13800	16500	22000	33000	44000
150	2300	6900	11500	13800	16500	22000	33000	44000
200	2300	6900	11500	13800	16500	22000	33000	44000

Note:—As a very large proportion of distribution transformers in sizes of 200 k.v.a. and less are used as single-phase units your committee has not attempted to recognize standard sizes for three-phase distributing transformers although it will probably be able to do so at a later date.

* This transformer has no taps.

rated 2400 to 120/240 and 2200 to 110/220, one line will be now manufactured instead of these two.

The new transformer replacing the others is to be triple rated, having a primary winding nominally designed for 2300 volts with a ratio of 20 to 1; this transformer can be operated at full rated capacity at any one of the following voltages with the same ratio:

2400 to 120/240 or 240/480.
2300 to 115/230 or 230/460.
2200 to 110/220 to 220/440.

The existing lines of 6600 volt transformers had different percentage taps on the primary and different ratios between primary and secondary. The majority of this type of transformer in use had a primary of 6600 with taps 6300/6000/5700, the secondary being 110/220/440.

As motor voltages had been standardized at 220 and 440 volts, and as the lines on which these transformers were operated covered a very wide area, and furthermore, as the load was of a seasonal character which does not justify the size of wire that would normally be used in congested city work, it was found necessary to work the transformer at over-voltage in order to deliver a sufficiently high secondary voltage at the motor.

This practice showed that the ratio of the transformer would have been better suited to Western conditions if the secondary had been 115 instead of 110 volts. To change this ratio would complicate operation, particularly on the coast where over 25,000 kilowatts of this style is now in use.

It was recognized that the future design of this class of transformer should meet the new condition which is tending towards raising both primary and secondary voltages and at the same time should maintain the existing ratio of the present class in order that the transformers would bank properly.

To meet these conditions it was decided that the old 6600 volt class should be redesigned; the new class to have a triple rating similar to the 2300 volt class and that the taps be based on 6600 volt operation in order to bank with the old transformers. The new transformer is to be known as the 6900 volt line and rated as follows:

7200 to 120/240 or 240/480.
6900 to 115/230 or 230/460.
6600 to 110/220 or 220/440.

The 11000 and the 13200 volt transformers have been similarly triple rated, the new class to be known as 11500 volts and 13800 volts.

The following voltages are recommended as desirable for distribution transformers:

High and Low Voltages—Distribution Transforcers

High Voltage		Low Voltage (Open Circuit)
2200	to	110/220 or 220/440
2300	**to**	**115/230 or 230/460**
2400	to	120/240 or 240/480
2200	to	575
2300	**to**	**601**
2400	to	627
6600	to	110/220 or 220/440
6900	**to**	**115/230 or 230/460**
7200	to	120/240 or 240/480
11000	to	110/220 or 220/440
11500	**to**	**115/230 or 230/460**
12000	to	120/240 or 240/480
13200	to	110/220 or 220/440
13800	**to**	**115/230 or 230/460**
14400	to	120/240 or 240/480
16500	**to**	**115/230 or 230/460**
22000	**to**	**115/230 or 230/460**
33000	**to**	**115/230 or 230/460**
44000	**to**	**115/230 or 230/460**

Note:—The voltage rating listed in bold type are considered the normal voltage ratings of these transformers and guarantees will only be made on the basis of these normal ratings. It is understood however that the transformers having triple voltage ratings will operate satisfactorily at any of the voltage ratings indicated as applying to that line. Name plates will indicate the triple voltage rating for the first group listed in the above table, but the name plates for all other lines will indicate only the normal rating, including taps. In all cases where a transformer has more than one voltage rating a paster will be placed inside the transformer cover showing the voltage ratings at which the transformer may be used in addition to the normal rating appearing on the name plate.

Several large systems now use transformers with a 115/230 volt secondary, having a 9 to 1 ratio. These systems find it impracticable to change to a 10 to 1 ratio on account of the size of the system and the number of transformers involved. This line of transformers will therefore continue to be made but in new developments it is recommended that the standards shown in the above tables be adopted.

It has been the practice of operating companies on the Pacific Coast to specify a three-voltage secondary rating on the 6900 volt line of transformers. In discussion at the New York conference the manufacturers showed that a cheaper and better transformer could be produced by adopting the two voltage combination (115-230 or 230-460) instead of the three voltage (115/230/460) and that the operating companies could save money by using a low voltage transformer or compensator stepping from 460 to 115 volts wherever it is necessary to deliver 115 volts from the same bank supplying 460 volts; this compensator or transformer would be cheaper than to incur the extra expense of having every transformer produced with a three-winding secondary as only a very few installations of the total made would utilize the 115 volt connection when 460 volts were supplied.

Series multiple connections with more than one combination in the low voltage winding of distribution transformers are particularly undesirable from the standpoint of best transformer design and construction should be confined to such combinations as 115/230 or 230/460 and not 115/230/460.

Taps.—Taps on transformers of voltages below 6900 should not be necessary in good Central Station practice, as potential regulators are generally used to compensate for voltage regulation.

Transformers designed for 6900 and 11500 volts are generally used on systems covering a wide territory and under conditions usually requiring tap connections to deliver the proper voltage at the consumer's service.

The following taps in the high voltage windings are recommended on the 6900 volt line.

5700/6000/6300 based on 6600 to 110/220 or 220/440 volt operation.

5960/6275/6585 based on 6900 to 115/230 or 230/460 volt operation.

6220/6545/6875 based on 7200 to 120/240 or 240/480 volt operation.

Where taps are necessary on transformers 11500 volts and above they should be confined to 2-5 per cent taps.

It is recommended that no taps be specified in the low voltage windings of Class "C" transformers.

It should be noted for the special benefit of those companies using 3-phase transformers that taps in this line of transformers multiply the complications by three as compared with single-phase units. Taps in this line should therefore be avoided where possible.

Transformer Impedance.—The question of standardization of impedance of distribution transformers was generally discussed.

It was the opinion that it is desirable for the manufacturers to work towards a common impedance, but it was felt undesirable at the present time for the operating companies to specify any impedance value, as such specifications would tend to hamper the satisfactory development of the art in the manufacture of transformers.

It was recommended that the manufacturer indicate the impedance on the name plate of distribution transformers in sizes from 50 to 200 k.v.a. so as to permit the proper selection for multiple operation.

Basis of Performance Guarantees

The following recommendations covering performance guarantees apply to all classes of power and distribution transformers.

(a) All guarantees covering characteristics and tests should conform to the A. I. E. E. Standardization Rules.

(b) Performance guarantees for transformers equipped with taps should be based on normal voltage and full winding. The temperature guarantee should apply to full k.v.a. loads at all standard tap voltages not exceeding a range of 10 per cent from normal.

ELECTRICAL POWER FROM LIGNITE IN AUSTRALIA

The city electrical engineer of Melbourne, in delivering his presidential address before the Victorian Institute of Engineers on March 22, proposed the building of a large power plant in Melbourne which would utilize brown coal or lignite, of which there are large deposits adjacent to Melbourne. From official statistics for the State of Victoria he showed that for the last 10 years there had been a steady increase in the number of factories utilizing electrical power and in the actual horsepower used.

	Factories Using Electricity	Actual h.p. Used.
1905	349	2,174
1907	558	4,182
1909	802	6,746
1911	1,164	11,764
1913	1,579	18,732
1914	1,782	22,584
1915	1,915	26,385

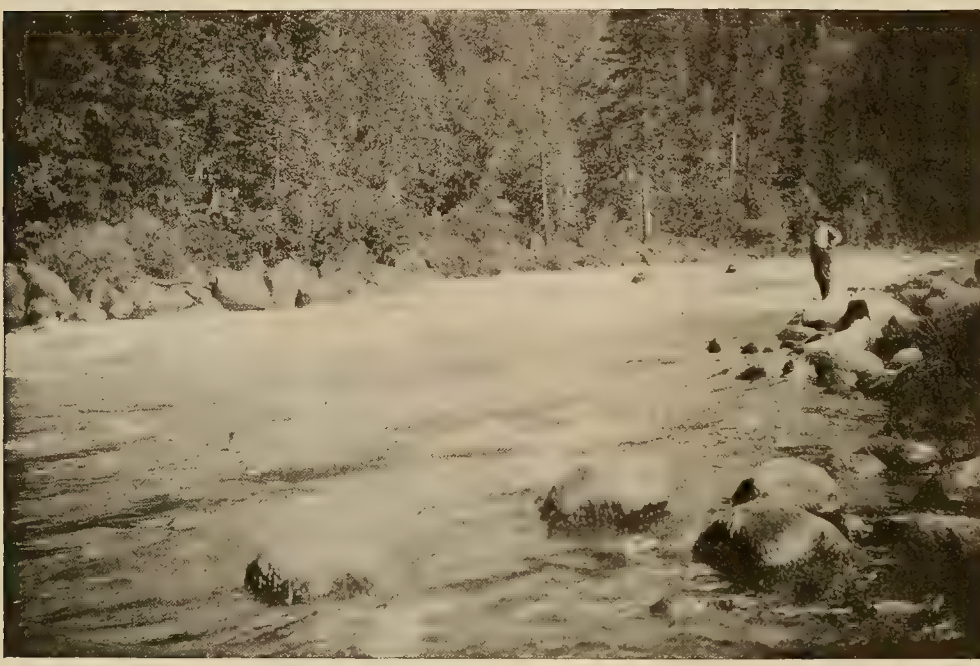
THE PIT RIVER POWER PLANT

BY JOHN A. BRITTON

(The newest and biggest undertaking by which the Pacific Gas & Electric Company proposes to harness the waters of a Northern California mountain stream for the generation of two hundred thousand horsepower was announced on page 404 of the issue of the Journal of Electricity, May 15, 1917. Interesting details of this great undertaking are herewith set forth by the vice president and general manager of this company, which will undoubtedly prove of intense interest to engineers throughout the West.—The Editor.)

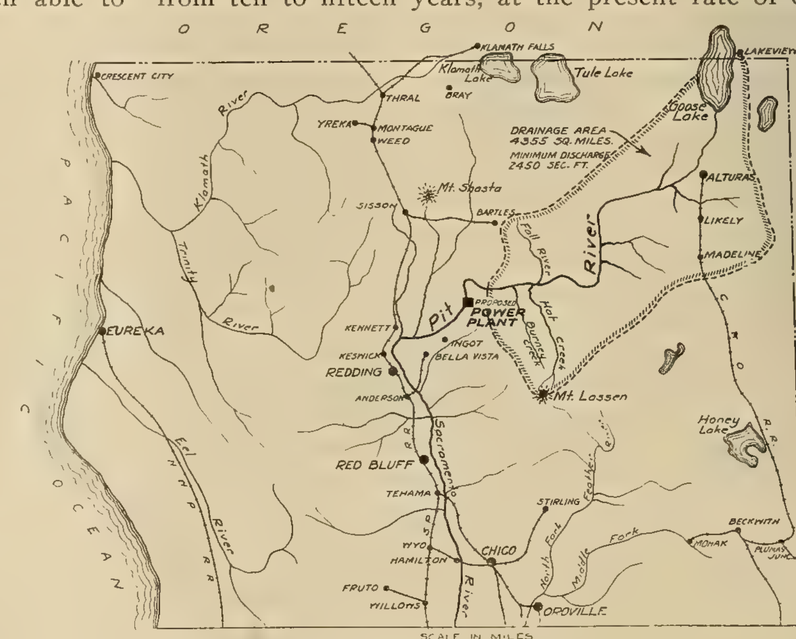
Some idea of the Pit River's potential development value may be gathered from the opinions of engineers, who have not hesitated to pronounce it the best stream in the state of California. But its development, so far, has been delayed, partly for lack of an active market for its output of electric energy. Then, again, it lies so far from the distributing centers that not until recent years have engineers been able to transmit electricity at sufficiently high voltage to cover the distance. The Pit River possesses an enormous advantage for power purposes in that its variation in stream flow during different seasons of the year is quite small. This is due to the volcanic formation of the country through which it flows on its way to the Sacramento, a volcanic formation that holds water like a sponge. This will be appreciated when I tell you that the minimum flow of the Sacramento River at Sacramento is 4000 cubic feet per second, and that to this minimum the Pit River contributes no less than 2450 cubic feet per second.

In view of the constantly increasing demand for electric power for various purposes, agricultural, industrial, mining and other, in addition to the domestic purposes for which it is almost universally used, the Pacific Gas and Electric Company has deemed it wise to keep a watchful eye upon prospective sources of addition to its electric distributing system. The Pit River project is an attractive one in every way, for it affords us an opportunity to develop at one point, in one power-house, an amount of electric energy more than equal to the present combined capacities of all the other power plants, eleven in number, owned and operated by the Pacific Gas & Electric Company. The amount that it will cost the company to perfect this development appears large at first sight; but when you measure up this total cost of approximately $17,500,000 with the amount in horsepower of electricity we will be enabled to place at the disposal of our consumers you will see that this entire project represents an average cost per horsepower remarkably low for any electric development.



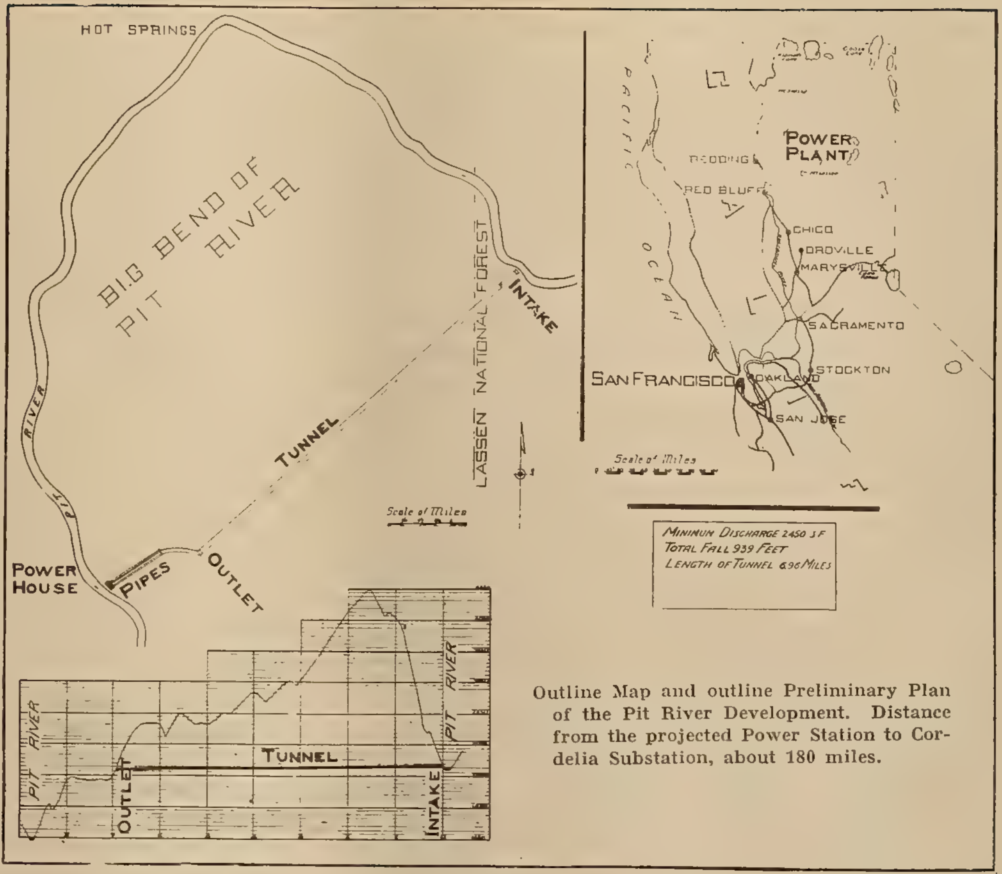
The Narrows, Pit River, Near Tunnel Intake

Furthermore, we calculate that this expenditure and its result will take care of our company's needs for from ten to fifteen years, at the present rate of our



The New Project and Its Drainage Area

growth. It will take approximately five years to complete the work which is already under way, but when these five years are up we will be in a position to meet all demands upon us. Man's inventive genius is ever at work and electric power has been brought into requisition in ways undreamed of a few years ago. The industrial feature of California's development is assuming larger proportions every day. This condition has been brought about by the availability of cheap electric power. The word has gone forth that every available acre of land in California is to be made use of to meet the food situation; and here, again, electricity comes into play. I think, therefore, that the public service corporations will have need of all they can manufacture and distribute in the way of electricity, gas and water in the years to come.



Outline Map and outline Preliminary Plan of the Pit River Development. Distance from the projected Power Station to Cordelia Substation, about 180 miles.

The Big Bend of the Pit River and Its Relation to the Great Power Centers of California

When the Wise power plant was constructed we installed the very largest and most modern water wheel up to then perfected. This wheel has a generating capacity of 18,500 horsepower. Our engineering force tells us that it is quite possible that by the time we are ready to purchase the necessary water wheels for equipping the plant at Big Bend, wheels will be manufactured with a generating capacity of 30,000 to 40,000 horsepower. In fact, Mr. Baum expects the water wheel and generator units to be about 50,000-k. w. capacity. This is no idle dream, since they are already manufacturing for steam plants units of 80,000 horsepower. Electrical science is progressing now by leaps and bounds. Ten years ago an efficiency of 70 per cent was considered excellent, whereas our Wise installation has an efficiency of 91 per cent. We look to this Big Bend plant to mark a new era in the electrical development not alone of this State, but of the world. For this reason we propose to follow the advice of our engineers and postpone the actual purchase of wheels and generators as long as possible, and, in fact, centralize the financing necessary for the development of this vast quantity of power in the last two years of the work.

THE THERMOMETER AS A PRESSURE MEASURER

According to the 1917 report of the committee on prime movers of the National Electric Light Association, with the advent of high vacuums, Bourdon gages became of little value in the determination of the turbine back pressures. Not only does the inaccuracy of this type of gage render it useless, except in a very general way when starting up, but continual changing of the atmospheric pressure makes its indications subject to large corrections. Even the mercury column has found a competitor in the thermometer, which in some cases has entirely displaced it. The fixed relation between vapor pressures and temperatures, regardless of atmospheric changes, gives the thermometer the preference as it is not affected by such changes. A thermometer having a range from 60 to 120 degrees F. and fitted with an overflow chamber large enough to accommodate the expansion of 240 degree temperature (to prevent damage to the instrument in case the vacuum is lost and the turbine operates non-condensing), is a much more accurate operating instrument than the mercury column. Such thermometers are easily read to tenths of a degree, whereas, to obtain the same accuracy with a mercury column, corrections would have to be made for total errors in excess of one-half of one-thousandth inch (0.0005).

The error due to the presence of usual quantities of air in the stream of a steam line is negligible. With a steam flow of 100,000 lb. per hour and an air leakage passing the thermometer amounting to 5 cu. ft. per minute, the error would be much less than five-thousandths (0.005) degree, which is equivalent to two ten-thousandths inch (0.0002). This is an excessive amount of air to be present at the turbine exhaust. Most of the air usually leaks in around the exhaust piping and condensor joints. The difficulty of obtaining an average temperature is no greater than of getting a location where the vacuum connection is not influenced by eddies in the steam.

MERCHANDISING ELECTRICAL ENERGY IN THE WEST

(The merchandising of electrical energy is a problem, the proper solution of which has far-reaching consequences throughout the West. Blessed with enormous potentialities for future power development, the hydroelectric industry in the West but awaits the careful analysis of economic marketing of this power and there will be ushered in an era of unexampled industrial and agricultural prosperity. Here is a discussion of timely interest, participated in by a number of well-known authorities on merchandising of electrical energy. It is from the stenographic report of the commercial committee sessions at the Riverside Convention of the Pacific Coast Section N. E. L. A., April 19-21, 1917. Its contents should receive an unusual welcome by readers of the Journal throughout the West.—The Editor.)

Chairman S. V. Walton: Our next subject for discussion is that of merchandising. In approaching the subject I am reminded of a definition that Mr. Frank A. Vanderlip, who said that the operation of the Chicago, Milwaukee & St. Paul Railway by electricity generated by falling water furnished him the very keenest idea of co-operation. As he expressed it, "Power generated by water is nothing more than the concentrated effort of millions of drops of water all falling in the same direction." And he said, "What can be done in this country when the millions of people all work together for the same purpose?" That is what we are striving to do in this merchandising problem. The merchandising of electrical goods and electrical energy go together. Each portion or each section naturally has an organization to carry it out to the best advantage. The central station has its field; the manufacturer has his field; the jobber, the dealer, and the contractor, and so forth. We have in this meeting here today representatives of all of those elements that go to make up this merchandising portion of our business. Mr. Childs, who has prepared the paper that is printed in the Journal of Electricity, is an expert on the merchandising business from the central station point of view. There are others here, who have proven by their flannel trousers and other signs of prosperity that they are experts in their branches of merchandising from other points of view. We will be glad to hear from all of them. I am going to ask Mr. Childs to abstract his paper.

A. W. Childs: The general subject of merchandising is not discussed in this paper. It is of too broad a scope. The intent of this particular paper is to discuss the relation between the central station, and the manufacturer, contractor and dealer, for the purpose of showing, first, why the central station began the merchandising of appliances; second, why the central station should continue to merchandise appliances, and third, the co-operative opportunity of the dealer.

I have endeavored to show the progress in the merchandising of appliances covering a period of about eight or ten years, beginning with the work of introducing the first lamp socket appliance, the electric laundry iron, showing how it was carried into the home by salesmen who worked from house to house, left the irons on trial, and after much effort succeeded in popularizing the laundry iron. And leading on from that, through the various stages up to the present time, when all electrical appliances are extremely popular, and in common use, I have shown that the preliminary work and much of the promotion work up to this time has been due to central station effort.

Then we pass along to the question of selling prices. The manufacturers tell us that there is a limit to the amount that the consumer will pay, there is a fixed limit to the cost of production, and between these two the dealer must get his revenue. On the other hand, there is a growing tendency to increase the lamp socket appliance cost to the consumer in order that the dealer may make possibly more profit on a smaller sale, and it appears to me that this is contrary to the purpose of the central stations all through these years in endeavoring to get a large output.

I have touched somewhat on the electric range promotion, showing that it is in its early stages, similar to the early development of the iron, with the exception that the great use of the smaller appliances has paved the way for the range and made its introduction much easier. I said yesterday that the harvest was now ready in the range business. That is true. However I might amplify that statement somewhat. The harvest is ready but the crop is small. The acreage planted is not very large at present, but the proper harvesting of this present crop and the replanting of the seed in the ground will bring in a much larger return at each replanting.

I have said that with the central station selling at list prices and confining its sale to appliances consuming 500 watts, approximately, and over, with a great deal of the more expensive appliances, that is, vacuum cleaners, washing machines and those articles which sell for considerable money and carry a fair merchandising profit, left entirely with the dealer, that such encouragement might be considered sufficient by some, especially when coupled together with the continued work which the central stations perform in creating the demand and re-creating it, and finding new uses for electricity, as was brought out this morning in the industrial heating discussion; and finding new sources of revenue for the manufacturers, jobbers, contractors, and dealers, outside of this appliance line.

I do not know just how far the central station might be expected to go in its efforts of co-operation. You have all met the fellow who asked for a cigar, when given it asked for a match, and when looked at inquiringly, said, "I will smoke it myself." Possibly you think the manufacturer of the cigar ought to furnish the matches, or that the cigar dealer ought to furnish them; if you are well supplied with matches you may be glad to furnish them yourself. On the other hand, a little girl five or six years old came to her father hand in hand with her chum, and asked for five cents. He was quite serious and chided her for asking for the money. As he was scolding her, but with a twinkle in his eye, she looked at her little chum, and whispered, "He is going to give it to us." So there you are. There is a great deal to be said on both sides.

Chairman: Mr. Childs' match story makes me think of the Scotch story that I heard the other day. A Scotchman, had lived in San Francisco so long he forgot he was a Scotchman. He had heard these stories about how close the Scotch are in financial matters. He went back to Scotland and visited a few months, and on his return to San Francisco he knew the Scotch were close all right. He said, "I left my hotel one evening, went down in my pocket and found I did not have a match to light my cigar. I stopped at the first cigar store I came to and said to the attendant, 'Can you give me a light.'" The attendant said he had no light, and I replied, "Well, out in San Francisco we have these electrical cigar lighters that do not cost you anything." The cigar dealer said, "Here is a box of matches for a half-penny." "No," I said, "I don't want to buy any, I just want a light." And, do you know, I had to walk clear back to the hotel, six blocks, to get my cigar lighted."

Before the discussion of Mr. Childs' paper starts, I want to give some figures I have just been compiling here. Late in November, 1915, our company started a co-operative sales campaign of lamp socket devices, participated in by the jobbers represented in San Francisco and the dealers in our territory, on a plan that has been heretofore published. The campaign was for fourteen months. The detailed figures as to all the results of the campaign we have been unable to get, probably never will get, because you cannot measure in fig-

ures the good will in various ways we have received as a result of this co-operative sales campaign. I asked the jobbers for some figures in general round numbers as to the number of appliances and wattage in appliances that they sold from the date of the beginning of the campaign up to its close. Of course, there is no way of telling how many they might have sold if this campaign had not been started, but I am going to give the figures, as they are rather startling in their size. The aggregate from all of the jobbers of lamp socket devices sold during the period of fourteen months, from the first of December, 1915, to the thirty-first of January, 1917, in the territory in which we operated very largely, was 45,000 pieces aggregating about 27,000 kilowatts. That is a startling figure when you get it all together.

D. E. Harris: Mr. Chairman—I am much interested in what you just said, due to the fact that Mr. Childs in naming those who are interested in the merchandise problem, omitted to mention the jobbers. I think you will agree with me that since we put out 27,000 kilowatts on the central station's lines that the jobbers play an important part in the merchandising of current consuming devices.

In getting back to this merchandising problem, I would like to reiterate what Mr. Britton said yesterday, regarding the importance of the electric industry to our country, and to the public at large; also, the desirability of unity of action.

The merchandising problem possibly can be defined as one of the businesses—I would like to define good business as that of buying and selling at a profit, satisfying and serving. We could possibly divide it into three parts, which would represent our industry: Capital the employer, the employe, the public the consumer. I do not believe that any industry can thrive if co-operation among the three is lacking, nor do I believe that any business can succeed that has a dishonest or indifferent partner; each owes a duty to the other.

In the past there has been a lack of understanding between the central station and those others that are interested in the merchandising problem. It seemed that the central station was taking the part of the lion guarding its prey; it was all this and the other fellow had nothing to say, I am convinced after attending the meeting yesterday and noting the enthusiasm displayed, that we have at last reached a common ground, where we can get together and consider the problems as one—central station, contractor, dealer, manufacturer, and jobber. We cannot get together as business men, which we all are today, unless we consider the problems of tomorrow. We are building up an industry, an industry that must grow for the future, and in building up that industry, let us work co-operatively. Let us believe in a "live and let live" policy.

Mr. Childs stated in his paper if the central station handled the selling it could utilize its buying power, absorbing the expense, and so forth. That is true, but, I believe, that was the policy in the past. It was the central station policy in the past, to buy in large quantities, and sell at a price which did not permit others in the industry to compete. It necessitated small concerns buying materials regardless of quality in order to compete, the quality of these goods must have reflected on the service of the central station. Mr. Childs went on in his interesting paper to state that in Los Angeles last year when the contractor-dealers were given at least half a show, they outsold the central stations in Southern California two to one.

On the subject of electric ranges Mr. Childs stated in his paper that he believed the electric range was the problem of the central station, and also, for the time being, the central station should continue to do the wiring. I am willing to agree for the sake of argument, that the electric range is a central station problem, but I cannot agree that the wiring is a part of the central station's work. The contractor and dealer, after all, must be considered, if we want co-operative work; if we want enthusiasm among those interested in this industry, we must co-operate with them, because when you destroy enthusiasm you are going to destroy the backbone of this business. The contractors, dealers and jobbers are interested in this problem.

I might define enthusiasm as being in deadly earnest. We do not want enthusiasm that is going to melt away when disappointments or obstacles get in the way, but the steady sort. The central stations can do a great deal towards keeping up the enthusiasm in all branches of the industry. As business men we should lend our co-operative support in building up the electrical industry, including the manufacturer, jobber, electrical contractor and dealer, that in the end we may all prosper and be a credit to the industry.

Mr. Wall: Women control education. Education is what we need right now, education of the public. There is a cornerstone. Many of the wives of the men here are members of women's clubs. I want these ladies to talk electricity while they are sipping their tea. They can be made to exert a tremendous force in educating the public. They can help us more than anybody else in supporting our propaganda for the electric home, in spreading home happiness abroad in the land. The romance of adventures of electricity appeals to women. It can be made to appeal to them.

I move that a publicity and educational sub-committee be appointed, at least one member of the committee to be a woman.

Chairman: Mr. Wall, I hardly think the motion is necessary. The recommendation going in our minutes is obvious. The points which Mr. Wall has raised are of importance, and they are obvious. I think every central station representative has done considerable work along the lines suggested by Mr. Wall. I think the possibility of having a public sub-committee of the commercial committee is a very good one, but should be left to the following commercial committee to handle.

Chairman: Who is the next victim on this subject of merchandising? Mr. Berry of the Western Electric Company.

W. S. Berry: I thank you very much, Mr. Chairman, for being called on for a few remarks. In opening, might say it is a great privilege for the contractors, dealers, manufacturers and jobbers to be able to attend these meetings and address you on some of the things in which they are interested.

Of course, the jobbers, of which I am one, have long realized that much could be accomplished through exchange of ideas. The commercial departments of the central station, being in reality a new organization, had to go through a process of education and try out some of their own theories, and see if they could not put on their lines devices which jobbers and dealers were also selling. This was unfortunate from the jobbers and dealers viewpoint, as the central stations, in forming this new department, generally put in charge men who knew nothing about the merchandising of goods and did not think it worth while to consult jobbers and dealers, who had spent years in working out selling campaigns.

Now, owing to the knowledge acquired through hard experience, the commercial department has taken a step in the right direction at this convention.

Large telephone companies are organized with four departments about on the same lines as your central stations and the commercial departments of telephone companies stand on a par with their other departments. The commercial department of the central station has not in the past been working along co-operative lines. In other words, each central station, I think, has been trying to solve its own problems of merchandising. Some of them have gone direct to the consumer. The consumer is the one whom the central stations, manufacturers, dealers and jobbers have all tried to reach, and some of the commercial departments of the central stations have done very good work along those lines. I, myself, believe that the proper method of distribution of electrical appliances is through the contractor-dealer. On

the Pacific Coast we have somewhere in the neighborhood of 3000 contractor-dealers who are awaiting the opportunity to get into the work and help dispose of these goods. Of course, it has been a hard proposition to educate these contractor dealers—I am speaking about approximately 95 per cent of them—as to the best method of merchandising goods. But we jobbers, together with some of the bright minds in the dealers' association, have been trying to work this out and recently have had considerable assistance given us by the Pacific Gas & Electric Company's commercial department. We have been working for the past six years to get the support of the dealers. This seems a long time, but before we accomplish what we expect, it will probably take six years more. I think we can now guarantee the central stations a majority of the 3000 electrical dealers on the coast working with one idea, the same idea as yours, to sell electrical devices to the consumer—when you have that organization educated properly, and doing a good job, then you have an organization that will help solve your problems and will put the goods on your lines in large quantities and at a reasonable cost. I thank you.

Chairman: Mr. Frank Somers, San Jose. "Don't Wurry."

Frank Somers: Mr. President, dear boys—I believe in God. I believe in co-operation. I believe in the proper distribution of supplies, manufacturer to jobber, jobber to retailer, retailer to consumer. I believe that the contractor and dealer is the natural and best solicitor that the central stations have today. Why? In the first place, he is cheap; he does not get paid in soliciting for the power company, but it is his bread and butter, or his success, and he goes to it with a vim.

I will just relate one instance to show you how I think all contractors are that. Three years ago the power company started out on an irrigation campaign. I worked night and day and Sundays educating people who never heard of an electric motor. I went from house to house and ranch to ranch, along roads where there would be no lines, nor prospect of lines. Some of these people had been called on every week for six months, and some of them every month for a year, and when I finally sold a motor, it meant the man had been educated for from six months to a year and a half. The result of that business was that I placed on the lines of the Pacific Gas & Electric Company in the Santa Clara Valley 3200 horsepower in small units, from 1 to 60 h.p., and one to each customer. I presented the power company with 1400 or 1500 h.p. they never would have sold, because the company's solicitor went along the one line, and if the man would not listen to him, he went on. I had to get the difference between the cost of crude oil and electricity. And if the man was not home and his wife did not know when he would be, I would wait until he did get home, even if I had to wait until after dark. I maintain out of that 3200 h.p. there was 1400 out of that that was due to my personal efforts.

The dealer believes he is a natural born solicitor, for the reason he is closer to the consumer; he is a smaller man; he is more on a level with the consumer. Of course, I have got some of my ideas from ancient history. Things have improved a great deal. But 21 years ago when I went to work for a power company, they kept the cashier in a cage, and they employed a bouncer who looked like a railroad policeman to throw the people out if they made any complaints. Of course they have since learned the fallacy of the policy "The public be damned," because they have found out if you have a man as a friend you are going to have him as a customer. While all these things are dying out, while there is a vast difference between the consumer and the central company, I suppose it will always be that the consumer will be down on the electric light company, the railroad corporation, and the telephone company, or the man who makes sugar. You will always hear the same statements, that the company gets the current for nothing, it is made out of water.

Chairman: Mr. Somers, will you discuss the lamp socket appliance business, while you are on your feet?

Frank Somers: From the lamp socket appliance standpoint I believe that bonus the company gave us last year was a Christmas present; I don't believe we earned it; we didn't work hard enough; it was too easy, when a man comes to get fifty cents for selling a curling iron heater that sells for $1.75 and costs $1.25. I think that is rubbing it in. I think they ought to put the bonus on the bigger horsepower.

The contractor and dealer ought to be the clearing house for the complaints, (and he is in many cases), between the lighting company and the consumer. He understands his customer better and he can deliver the goods.

And I also maintain, coming back to the supply proposition, if you put the central station and the dealer on the same basis, give him the sale prices, or the same goods at the same prices, that the central station would be mighty soon out of business. My place of business is next door to the power company's office; I have been established sixteen years. When they sold lamps at 25 cents and I sold them at 30 cents, I still sold $2500 worth of lamps, and when they sold irons less than I did, I still sold irons. I maintain the public would rather deal with the dealer.

Some years ago, the electrical contractor found it uphill work to attain success or even earn a living. His greatest difficulty was in trying to compete with the power companies, it being impossible for him to sell goods below cost as they did.

Wiring was then in its infancy.

Poor work was done by both contractors and power companies—any makeshift to deliver the current. The power companies doing a broader business and having more money, soon found out the difference between good and bad wiring and from that time on ran rough shod over the contractor and dealer. Not understanding this, many have made good, and are today successful business men, but they do not co-operate with the power companies because they have naturally been made to feel that the power company is their greatest enemy.

The day of co-operation through the electrical industry is at hand and it is up to you, broad big business men to meet the contractor half way and let him know that we are all working toward the same end, the electrical industry on the biggest possible plan, manufacturer, manufacturers' agent, wholesaler, central station, electrical contractor and dealer "all together all the time for everything electrical."

Chairman: Mr. Walton of the Southern California Edison Company.

C. S. Walton: I am impressed by the remarks that have been made, and agree with them in the main, but I wish to call attention to the fact that the problems which are presented to us in this particular matter are not unlike those which were dealt with yesterday, because the large company and the small company have to meet them in different ways. The large company has solved a great many which the small company cannot solve from a recital of the conditions which are now prevailing with the large companies. I have heard it said, and it possibly is quite true, that the large companies do not derive any great benefit from either the national meeting or the sectional meetings, or better perhaps that they do not derive in measure as much benefit as the smaller companies.

It seems to me that it might be said that the jobber, the contractor, and even the manufacturer, is the product of the central station. In the case of the small company, remote from the jobber, remote, of course, from the manufacturer, and with possibly only one or two small dealers to co-operate with, it would be justified, for the time being, in making its own campaign and not necessarily considering, to the detriment of its interests, the small dealer.

I feel sure that the wonderful saturation which some companies are experiencing in lamp socket appliances on their systems, would not exist if it had not been that at the start

the company itself, with its facilities for reaching the consumer, ignored for the time being the interest of those in the business more indirectly. It seems to me that we have arrived at a fortunate condition in those companies where the public are educated to have confidence in the lamp socket appliance and regard with favor any new appliances brought to them. Under such conditions it is most desirable that the prices charged by all should be exactly alike, and the burden of the distribution might then be left with the contractor-dealer. I am happy to say in the company I represent that condition prevails. We maintain prices; in fact, we maintain prices so faithfully that we are being undersold every day in the department stores and by some dealers. But we are well satisfied. The goods are going on our lines and on those of our friendly competitors. The object of the companies is served by the building up of the load, and we are very glad to see them undersell us.

But in the small companies in the smaller towns, I believe a great deal of work will still have to be done by the central stations. I believe they are justified in doing it until such time as their public is properly educated to the benefits and uses of lamp socket appliances, when naturally the dealer and others interested in the sale of such goods may come in and take their place, and then it is highly desirable that the central station should maintain prices and co-operate in every way with the dealer.

Chairman: Mr. John M. Morris, will you kindly come to the front?

John M. Morris: In working towards better co-operation of the three big industries, a detail was called to my attention that I would like to have discussed here, and that is in the development of this business the central station often sells appliances on terms to the consumer. That puts the dealer up against it as he is not in position to give that credit to the consumer, principally because he is not in position to collect the payments.

I would like to ask two questions: First, is it necessary or desirable in order to get out these lamp sockets, to give terms to the ultimate consumers of say a dollar down and payments for two or three months. And if it is necessary, can it be satisfactorily arranged so it can be worked out?

I suggested a scheme to certain central stations working that out along the line of the dealer selling the goods and delivering the apparatus on the approval of the credit by the central station, and then turning the accounts over to the central station. I would be very much interested to know if that problem has been worked out in other parts of the country.

Chairman: Mr. Morris' questions are apt, and before we ask for an answer from the central station men, I would like to ask an electrical contractor and dealer who is exceptionally qualified to speak on those subjects—Mr. Kimball of Oakland.

Hugh W. Kimball: Mr. Chairman and gentlemen—In regard to the question asked as to the manner of handling the sale of electric appliances on the term payment plan, will state that there are several different ways of doing this. One central station formulated a plan whereby the dealers could turn over to them their contracts for appliances sold on the installment plan, adding ten per cent to the regular re-sale price for the handling of the account by the power company, covering monthly payments on a period of ten months, or more. The dealers were given this privilege but I believe that the plan was used but little. However, the plan was mapped out wherein it could be handled with little trouble, as the collections could be made by the central stations together with the collections of the regular monthly bills for current. I think most of the electrical dealers handled their own installment payments, offering the public credit extending over a period as high as ten months' time, and experiencing little difficulty in financing the matter. It is certainly necessary that appliances be sold on the monthly payment plan as the various department stores, furniture houses, etc., are offering and advertising the long monthly payment plan on similar articles as well as on electric devices, vacuum cleaners, washing machines, etc. My own firm is still carrying on this plan and find it easily handled. We find, however, that fully seventy-five per cent of the customers do not want to be bothered by installments, so that in itself it is a minimum consideration. We thought at first that it would be necessary to take this matter up with our bankers for the purpose of handling the paper which, of course, could be easily arranged by any firm but the volume was so small in comparison with the total amount of business that it was not necessary and I believe that any ordinary firm or electrical dealer could offer such a plan to the people and find no trouble whatever to extend all the credit necessary. Of course if it should reach to any extent they would have their bank to fall back on.

Chairman: Does that give you an answer on it, Mr. Morris?

J. M. Morris: Yes, thank you.

H. W. Kimball: In regard to the work of the contractor-dealer in co-operation with the central station on the output of current consuming devices, and of course, ultimately the consumption of electric current, in Mr. Halloran's report yesterday I was a little surprised to find the great number of central stations in California and the large majority of members of this organization represented by the smaller companies. Before going further I wish to say that for some time, as mentioned by Mr. Berry, the electrical jobbers and contractor dealers have met on the common ground of organization for the betterment of the electrical industry, better salesmanship, broader and bigger business methods and general co-operation with other factions of the industry. We have formed the California Association of Electrical Contractors and Dealers and for some years have been meeting regularly for the purpose of co-operating on this plan. Our work has been largely educational and we have made rapid advancement in the art of merchandising and handling our business. Some years ago the idea of an electrical contractor and dealer handling the exclusive sale of appliances would have seemed to me to be out of the question, but we are well organized now and have made remarkable advancement in our various businesses and I feel that we are at the point where we can handle the entire output of current consuming devices and handle it to the betterment of the central station people as well as the manufacturer and ourselves.

Now in regard to these smaller companies, I think the great problem pertaining to the sale of electric appliances and getting them into the hands of the consumer is not in the large cities but rather in the smaller towns, and the central station people could give a great deal in assisting the California Association of Electrical Contractors and Dealers in getting the proper people in their various districts for the handling of this product, with the result that in a short time every district and every community will have a well established representative dealer. The jobbers of electrical appliances have assisted the contractor-dealer in the advance of this business; they have instructed the various salesmen on the road to interest their customers in this movement and to educate them along the lines of co-operation in sales effort. If all the central station men in their various districts will bend an effort this work will materially increase to the benefit of all.

The central stations must realize that every well organized electrical dealers establishment, every electrical salesman and every electrical mechanic conducting himself in the proper manner is an additional salesman of kilowatts from which you will directly benefit and he is not on your payroll either.

I have visited a great many of the smaller towns in California and I find that almost everywhere there is a sort of loggerhead condition between the central stations and the

various dealers in the towns. The central station man's attitude is that they do not believe that the man engaged in the electrical business in their particular district is capable of meeting the public properly on electrical problems. I do not know but that to a large degree this attitude is justified, but nevertheless it does not tend toward progress in the industry. Of the two, the central station man is financially stronger and more securely placed in the community in a business way and he can materially help or hinder the progress of the local electrical contractor dealer in his district and by so doing help or hinder his own progress. Bear in mind that in the San Francisco Bay section alone there are upwards of 3000 men engaged either in the business or in the employment of men who are in the business of selling and installing electrical equipment and every one of them is indirectly a seller of kilowatts.

If the central station men will take an interest in this movement, give a little encouragement, a few suggestions now and then and support generally to their various dealers, I am sure it will help. The California Association of Electrical Contractors & Dealers want to see their organization well represented in every district. If there is any central station man who believes that the contractors and dealers of his section are not of the proper kind, our association can aid him in interesting the proper people to locate in his district or if the electrical dealers already established in any section are not bending their efforts in the direction of progress we are ready to assist you in their betterment. A letter to our secretary's office in San Francisco will start this movement. Interest yourself in the electric dealer, encourage your local men to join our organization and we will help you make of him a good salesman of your product.

T. E. Bibbins: I have read Mr. Childs' paper with a great deal of interest and indorse it almost in its entirety. The one or two points I take issue with are not important. The paper itself is historically correct and logical.

I am impressed with this: That the problem of selling becomes easier as the articles are sold. The most difficult thing to do, as any seller will recall, is to dispose of the first article and see that it is well sold. In other words, that it stays sold, and that article then sells another and so on.

For that same reason, it was necessary for the central station,—and particularly the Southern California Edison Company,—to start its campaign of sale, and the work that it has done is undoubtedly monumental. The same situation applies today to the range. I agree with Mr. Harris that the sale of ranges is not a dealer problem today. It is the duty of the central station to start the campaign. I do, however, feel that the connecting up is distinctly a contractor-dealer proposition.

Now, this organization, I understand, is not a charitable organization. It is neither a branch of the Red Cross, nor in any way is it here to dispense charities, and therefore, what we are here for is to exchange ideas and find the logic of the situation. If the manufacturers, jobbers or dealers, who are obliged to sit on the outside while other branches of the industry sit within in its deliberations, it cannot be as productive of good as if all sat together and conferred on each phase of the whole problem. We believe, speaking from the jobbers' standpoint, that we have a right to exist. In other words, there is a part in the struggle of life in which we have a place. We believe also that our associates, the contractor-dealers, have a part.

Some people are rather inclined to feel that after all, the jobber, not particularly an electrical jobber, has not a right to exist; that it is a fungus growth. Perhaps it is in many commodities, but in the electrical problem, it can demonstrate its right. The electrical jobber brings together the interests of a great number of diversified manufacturers; he brings the conduit, made by one company, the rubber-covered wire made by another, the pole line hardware made by another, the incandescent lamp by still another, and so I might go on. He brings them all in under one selling organization, all under one roof, and because of that fact, he is able to administer the problem of distribution for the various manufacturers as they individually could not do. Therefore the jobber performs a function, and he must of necessity ask his price in order to pay his expense.

The contractor-dealer is theoretically so distributed—competition makes it so—over the territory, that he in turn performs a function, and that he is, as it were, the nerves in the tips of the fingers for all the other industries.

I contend, gentlemen, that this business of ours is made up of four parts, and each part is essential to the other: the manufacturer, the central station, the jobber, the electrical dealer; one without the other could not perform the service which we jointly undertake; and, therefore the reason and logic for this meeting.

To my mind, Mr. Chairman, as Mr. Kahn has put it, this commercial meeting is the backbone of the whole. The responsibility of the engineers is to find a way to carry out our idea. All that the bookkeeper does is to account for the things that we do. And so, gentlemen, according to my theory, we are the ones that really cause the blood to flow all through the body. Now, if all parts of this body that I have referred to are properly served, if it is hardy in its growth, each must partake of the heart's blood; Mr. Contractor and dealer must have his profit, must have his right to exist; therefore, any policy which is destructive of that part of the body, such as a low price campaign, which destroys that particular part of the body interferes, in the end, with the growth of the whole body.

In the performance of the central station function the dealer should be borne in mind and to do this the other side of the problem, should be presented so that we can all logically work forward to the end of serving the public, and that is, in the final analysis, the only warrant we have for existence—that of service. (Applause.)

Chairman: Mr. Bibbins has stated his case very clearly. I would like to get back for a minute to the questions raised by Mr. Morris, and get an expression from the central stations. I think Mr. Newbert of the Pacific Gas & Electric Company has a good idea on that very subject of installment payments.

L. H. Newbert: Mr. Chairman and gentlemen—Regarding the question which Mr. Morris raised of carrying the installment payments for dealers: The Pacific Gas & Electric Company, made such an arrangement some eighteen months ago. When we did so, it was thought that there would be quite a demand for installment terms. However, such did not prove to be the case during the campaign that Mr. Walton referred to; that is, very few of the dealers apparently found it necessary to call upon the company to carry the deferred payments for them. I have asked some of them why that was unnecessary, and found that the most of them are able to arrange to carry those installment payments themselves and thereby earn for themselves the extra ten per cent which was charged. Others who were not in a position to carry them themselves were able to make satisfactory financial connections whereby they were able to get the money at less than 10 per cent, and getting an extra 10 per cent on the sale, made them a small additional profit.

The installment plan we know well. In other lines it has resulted in a great many more sales than would otherwise have been made. Particularly is that true of the publishing business. I think probably every one of us in this room has purchased books because of easy payment plans that we would not have otherwise purchased, and I, myself, have been somewhat at a loss to understand why there has not been a greater demand for installment terms in connection with the sales of appliances.

I think it is true that in the earlier days the Southern California Edison Company and some of the other companies in Southern California found that that plan worked

out most satisfactorily and resulted in enormous sales, sales that in all probability could not have been made on a cash basis. However, for some reason that has not been the experience of our company, except possibly in connection with the sale of vacuum cleaners, which, of course, is not a particularly attractive load to the central station. The vacuum cleaners in our section are sold largely on the installment plan; so is the electric washing machine, but the smaller devices are generally not sold on that basis.

Chairman: Mr. Simpson of the Federal Sign System (Electric) will now address us.

T. W. Simpson: I ask you gentlemen not to be alarmed as I flash this paper on you, that it will only take four minutes to read it, which is within the time limit.

The argument I desire to place before you can best be presented by a series of suggestive glimpses of Western conditions of fact that you can all verify.

(1) There is one city that I believe all agree possesses the poorest and most backward electrical conditions in the West. I refer to Tacoma, Washington. Electricity rates are absurdly low. It is served by a municipal plant that sells nothing but electricity, and does not compete with the electrical sales industry in any way. Here one would think the electrical dealers would be in clover. Yet Tacoma has comparatively the fewest electric ranges, the poorest and cheapest electric signs, the most miserable window lighting, and is way, way in the background when judged by any of these standards by which we judge a city electrically.

(2) The Salt Lake City central station believes in aggressive dealing in load building devices on a scale greater than that found in any other city of the West. It does not limit itself to articles of less than $5.00 as does the Southern California Edison Company but sells anything and everything. Its policy is live and let live in that it does not cut prices, yet it sells on long terms and does everything else to get the business. There is no city in the West where the electrical industry, dealers and central station alike, is in a healthier condition than in Salt Lake City. As an example, the Salt Lake City central station sold over 350 electric washing machines in the first three months of 1917, yet it is a fact that there is a single dealer in Salt Lake City that sells seven hundred washing machines a year.

(3) Southern California Edison Company and Pacific Light & Power Corporation have served Southern California on the plan of the patch quilt. Hollywood and South Pasadena would be P. L. & P., Monrovia, Pomona and Long Beach would be Edison and so forth. The communities are similar, yet until a few years ago the P. L. & P. did not campaign electric appliances while the Southern California Edison actively engaged in the work. Strange as it may seem, a shrewd electrical salesman would go to Monrovia, Pomona or Long Beach with a far better assurance of making a success than if he went to Hollywood or South Pasadena.

(4) In 1915 the Federal Electric Sign Company operated an electric sign campaign with the Pacific Gas & Electric Company at Oakland. Our Oakland competitor saw ruin staring him in the face because he was not in on the campaign. The facts were that our competitor did so much business during the central station Federal campaign that he bulged clear out of his factory space and was building electric signs in the vacant lot adjacent to his factory. The electric sign permits showed his business was more than double that of the previous year. Similarly when the shoe was on the foot at Butte, Montana, and the central station was operating a campaign with a competitor and not with us, we found it easier to get business in Butte than ever before.

The reason for the conditions rests in the fact that load building devices are not a staple line. There is no demand unless it is stimulated. It is a specialty business that requires book-agent salesmanship.

Book-agent salesmanship costs money. Concerns handling lines that require this class of salesmanship cannot survive if the cost of goods exceeds 60 per cent of selling price if the goods are sold for cash and require no "after service" as we call it. They cannot survive if the cost of goods exceeds 50 per cent of selling price if the goods are sold on term payments and require no "after service." They cannot survive if the cost of goods exceeds 40 per cent of the selling price if the goods are sold on term payments and carry liability of "after service," such as free repairs, adjustments, or allowances. A patent potato peeler that the house-to house salesman sells your wife comes in the first or 60 per cent class, a phonograph or set of books comes in the second or 50 per cent class, and electrical devices mostly come in the third or 40 per cent class.

It is true, there is a very limited staple demand that can be met successfully by "over-the-counter" sales if the goods cost about 25 to 30 per cent more than the figures stated above. But that demand will never give the central stations the load their stockholders are entitled to see on their lines. No central station that depends on the staple demand to foster the sale of load building devices is tilling its field as it should be tilled.

But an electrical dealer cannot buy his goods at a sufficiently low price to permit book-agent salesmanship. Instead of an electrical dealer being able to get his goods at 40 per cent of selling price, the average cost of load building devices to the dealer or contractor is 65 to 70 per cent of the selling price. The margin is however sufficient to pay handling and sales cost in supplying this minute staple demand and this justifies the existing prices, and no claim is made that manufacturers should increase their discounts.

Consideration of these facts will show that it is better to have the central stations actively compete with dealers, since this increases the staple demand, than it is to have the central stations passively co-operate by withdrawing from activities.

The next thing is to show a plan of co-operation that will bring the results. It does not consist in financing the term payments. It does not consist in having central stations collect term payment accounts and turn the amounts collected over to the dealer. It does not consist in moral support or advertising "go to your dealer," etc. It does not consist in the central station buying advantageously and selling to the dealer at a better discount than the dealer could buy for himself nor does it consist in any combination of these. Advantageous as these are, they do not represent the solution.

The one and only solution is this: The central station should take the money that it would lose in its new business department if it sold devices, and distribute it as a bonus to electrical dealers proportionate to their load building activity.

First off you may say that a central station new business department does not lose any money and in reply I challenge anyone to show a report proving that fact. If anyone does, I will shoot it as full of holes as your committees do the reports of the success of municipal plants. The merchandising cannot properly be done except at a loss. The best merchants have tried it and failed. The best central stations have tried it and failed, but the central station can well afford to fail and conduct it at a loss, but a merchant cannot.

Next, you may say, how does it happen that the Federal Company has succeeded in merchandising load building devices without this bonus, and I reply that it is because our line carries a high gross profit and I receive definite central station co-operation so my "after service" and collection expenses are very small. A prominent vacuum cleaner dealer selling to consumers through several stores also succeeded because he bought his vacuum cleaners at 40 per cent of selling price, the criterion figure of success for this class of business.

There has been no success in the electrical merchandising field that violates these principles and if it is attempted to violate them the electrical industry will lapse into the sleepy state of those localities such as Tacoma that depend on the casual or staple demand only.

Now, face the fact that your load building is costing you three, four or six months estimated revenue and distribute that on a proper plan to the dealers who can show devices sold and in use. Then you will get results, and enthusiastic support and an element of good will for your company out among your consumers that is worth more than most any other asset.

If you cannot do this, stay in the load building device business with both feet since the fringes of your activity and the crumbs from your table will be bigger than anything the electrical dealers can develop by going it alone.

Chairman: Mr. Simpson has raised some interesting points in his paper. One of his points has to do with the cost of the goods. There are a number of manufacturers represented here. I am going to ask Mr. Booth of the Hotpoint Company, whose factories are nearby here, if he will not talk to us.

P. H. Booth: Mr. Chairman, the subject of 40 per cent has come up so suddenly that, at first glance, in these times of rising materials, it is apparently out of the question. But matters that are out of the question on first thought are not always out of the question on second thought, or on further consideration and study. So I would not say right now that we should throw down or eliminate the thought of some day being able to reach a greater gross profit for distributors. As Mr. Childs ment'oned in his paper, there is a limit which the consumer will pay, and there is a limit to the cost of production, and if between these limits the 40 per cent comes in, we will be very glad to hand it out.

I think it is a great credit to the electrical industry, as a whole, that it is so broad-minded as to take in every branch of the industry so as to discuss problems of this kind as broadly and as fair-mindedly as we have in the meetings yesterday and today. It is certainly a great credit to the caliber of the men interested in the electrical industry.

The part that the manufacturer plays is one where we are all interested with you, and we must live, as the central station must live, and the dealer must live, and the jobber must live. We all have the same object in mind to obtain—a fair profit on the work we put forth—goods we deliver must be goods that represent a fair price to the consumer and a fair value to the consumer. Therefore, in view of the broad-minded attitude with which we are approaching the problem, its solution is near, as I see it, and it is nearer than it ever was. It is a great comfort to feel we have this problem outlined before us, and I am sure much good will come from a careful analysis of it.

It was not long ago that we heard the familiar phrase "competition is the life of trade." On this basis, the legal department of the government of the United States used to work most aggressively to bring about competition in the various industries and in the various public utilities. Today, they have been brought to realize the folly of an extended intensive competitive condition. This is an age where "co-operation is the life of trade" instead of competition. This spirit of co-operation to augment and build up the endeavors of the industries of the country, has been legalized by the various departments of the government and makes possible associations of manufacturers with their dealers and their clients, such as this association. Furthermore, the government accepts the legality of these associations, feeling that with this friendly spirit of co-operation, industries are encouraged, fostered and built up much more rapidly and much more substantially than if the former policy of intense competit'on prevailed.

I think that a great many of those present did not give as much serious consideration to the meat in Mr. Childs' him and discussed by the committee, the various angles of the merchandising situation were gone into carefully, and Mr. Childs has tried to present to you a concrete line-up of this problem and the various elements that go into it. I am sure that Mr. Wall's idea of publicity plays a very important part, and Mr. Childs touched upon this in his paper, that first must come the publicity, the desire to buy, and then comes the resulting problem of how that demand should be satisfied. The question of the solution of the problem is one that will undoubtedly come soon, but the solution will not come definitely, as I see it, all of a sudden.

In solving a problem, as concrete, and yet as complicated as this is, we must naturally take into consideration the personal element, the personal equation of the component parts of the problem that must be solved. This personal equation will vary greatly (as has been pointed out today) in the various districts, towns and companies, including the central station, jobber and dealer, in which the problem presents itself. But by bearing in mind, as Mr. Harris has said, that we must live and let live, at the same time, considering the personal equation that has to be contended with, I am sure that the solution will be worked out. It may be a little different in the various parts of each locality, but with all minds working together, with one object in view—to increase the sale of appliances, thus increasing the revenue for the central station, dealer, jobber and manufacturer—much good will come from the united effort.

Chairman: I wish we could have the time to hear from all of those in the room who are prepared and inclined to speak on this subject. I am going to ask one other manufacturer to discuss this point raised by Mr. Simpson. I think Mr. Alvord of the General Electric Company is qualified to discuss this for a few minutes.

R. M. Alvord: Mr. Chairman and gentlemen—This ques-question of co-operation between the central stations and jobbers, manufacturers, and dealers, is one that has interested me for several years. I have a suggestion to offer for your consideration in connection with a point mentioned in Mr. Simpson's paper: The Society for Electrical Development has done a great work nationally in co-operative advertising and publicity. The points that have been brought out by your discussions here show that we need to do a lot of work locally to assist in creating a demand for the use of electrical devices and that we must help the national campaigns to educate the housewife, her husband and all the children to use electrical appliances. We must make them want and want very much to "Do it Electrically."

I believe that the money which Mr. Simpson suggested might be supplied to contractors and dealers as bonuses, would secure the greatest results if it were spent in a co-operative movement confined to the territory of this section of the National Electric Light Association, I believe all will agree that a certain amount of money used for co-operative publicity will be more effective in salesbuilding than it possibly could be when divided into individual bonuses resulting in scattered and more or less ineffective efforts.

Very few of the dealers have the advantage of advertising experts in their organizations—a co-operative organization may command the best, and then there is a decided advantage in the larger purchasing power effected by the co-operative plan. I therefore favor the co-operative way.

The expenditure of this fund should be under the direction of a joint committee consisting of the commercial committee of the National Electric Light Association and of a committee from the Contractors' Association. The work undertaken might include general co-operative advertising paid for from the fund—the stimulation of local co-operative sales and advertising campaigns, the distribution of educational newspaper articles and, most important, encouragement and assistance to dealers and central station men in their efforts to study and become more effective merchandisers. This work may be made general for the states in this geographic section,

or at the discretion of the committee it could be localized, depending on conditions in northern and southern California, in Arizona, Nevada and New Mexico.

Chairman: Mr. Alvord, before you finish, will you discuss the percentage of gross profit matter from your point of view?

R. M. Alvord: Yes. There is one other point that I think is worth consideration by the central station. I am vitally interested and feel that the dealers must believe, and the jobbers, that we are all dependent to a large extent on the success of the central station, and the growth of their business It means bread and butter to all of us.

There are, as Mr. Berry pointed out, some three thousand electrical contractors and dealers on the Pacific Coast. It is possible to make every one of these contractors and dealers a more active efficient salesman for the central station industry, and for our industry as a whole.

The National Electric Light Association has spent a great deal of money, and the commercial section has spent a great deal of time in developing sales training courses—a correspondence school in salesmanship. Why not go a little further and extend the benefit of that course, training in salesmanship, to all the dealers and contractors? The fact that they are here with you today indicates their desire to co-operate with you, and I am sure they would be glad, many of them, to take advantage of an opportunity of studying that course in salesmanship and merchandising.

Mr. Walton has asked me to speak on the subject of dealers gross profit on appliances. I am not in a position to say very much to you regarding it. Mr. Childs in his excellent paper, Mr. Booth and others before me, have suggested a need of careful study of retail prices and dealers gross profits. I agree that there is a limit to the retail price which can be secured. There is also a limit below which it is difficult to manufacture. I believe, however, that the question of the price at which appliances can be sold to the consumer and the difficulty of getting a proper price, is sometimes given too much consideration. I believe that with quality goods, right merchandising methods and good salesmanship, devices can be sold to the consumer at a price which will allow a fair profit to all sections of the industry, and that those prices would not be so high but what we could be confident in our own minds that in selling at those prices we are doing our customers a real service.

If we thoroughly know our goods and the services that they render to the housewife we will be enthusiastic about the value of our electrical appliances, and fair prices will seem low or at least reasonable to us. Then with ability as salesmen we can convey that state of enthusiasm into our customers' minds and they too, will want to "Do it Electrically"—will want the appliances we offer and will feel that our prices are reasonable. Therefore, I recommend that all of us and all our associates in the industry use more ourselves the services and the appliances that we are trying to sell to others, and also that we take advantage of every opportunity to improve our skill as salesmen. The first will give us a greater appreciation of the value of electric service and will minimize the question of price. The second will increase our power to make others want—very much—to "Do it Electrically."

Chairman: Is Mr. Woodill of Woodill, Hulse Company of Los Angeles here?

H. B. Woodill: I believe we are entirely too timid about the profit idea. I have listened to Mr. Simpson's paper with a great deal of interest. I can recall a few years ago when the manufacturers thought it was impossible to allow the dealers over a dollar profit on each fan sold, and then he had to contract for a number to even make that much. They have changed that now and are allowing us a little better margin.

If you will look over the commercial ratings in your financial reports as to the merchants who are scccessful in the different lines, you will find that the hardware merchants very seldom fail, and the druggist never, because he makes a large margin of profit. This cannot be done unless the profit will take care of the overhead and a balance besides.

I can readily see where the manufacturers who have sold through the lighting companies hesitate about increasing the prices. He made his manufacturer's profit and sold his output to the lighting companies and it was therefore nothing to him whether they sold it at a profit or gave it away. They also took refuge behind the fact when we went to them that the entire matter was handled by the lighting companies and that they were powerless to change it. This is different now, thanks to the lighting companies gradually changing attitude, and I believe if the lighting companies assist, the dealer will take up the white man's burden and push the sale of appliances even better than they could.

If you will look back over the past ten years you will find that most all electrical dealers have failed. One reason because he was not a business man and sufficiently educated in business methods, the other was, and the principal reason—that the margin of profit was not large enough. It used to be that let an electrical salesman go to a department store and offer to sell them goods, they laughed at him and said they did not care to handle that sort of merchandise, as the margin of profit was not sufficient. We are endeavoring to install department store methods in our business, and with that idea in view, following in the footsteps of some other large dealers, we are taking up the sale of all appliances on the installment plan. It is for that reason of great interest to me to hear of a man in Salt Lake who sold so many washing machines. Los Angeles is in a particularly good position to take the burden of the sale of current-consuming devices off the hands of the lighting companies, as we have a half dozen or more thoroughly up-to-date retail electrical stores, and therefore are in a position to sell all the appliances there is a demand for, and I think in a more satisfactory manner than the companies' own department for handling this class of business.

Chairman: It would not be right to close this meeting when we are discussing merchandising, without hearing from Mr. Scobey. Mr. Scobey is the proprietor of the "Home Electrical" in San Francisco.

M. L. Scobey: I was much interested to note the remarks of the central station operators here, in that they are commencing to recognize the ability of the dealer. Three or four years ago the contractor and dealer was not thought very much of, and rightly, because the central station at that time was selling goods at their cost, which was probably lower than the cost to the contractor or the dealer. Today they have changed their minds. They realize that the contractor and dealer has become a better business man, that he has learned more of business methods, and is in a position to carry on the sale of socket devices, as well as other electrical devices.

The central station does not fully realize what the contractor-dealer can mean to them in the future. We have come down here to ask for your support, that you place a little more confidence in the contractor-dealer than you have in the past. I believe we can show that we can give you results, and eventually take the burden of merchandising the socket devices, lamps, and so forth, entirely off your hands and give you results that will be plain and readily seen on your books.

Practically all the electrical dealers and contractors are members of the state association, and meet at least once a month, and locally every week, to discuss the problems of contracting and merchandising.

Selling to women is one of the problems that has been vital to the dealer. Perhaps 85 per cent of the socket current devices are purchased by women. The electrical dealer now has a store, that invites the women's patronage. Two or three years ago that was not the case, as the contractor-

dealer could not afford to put the time, money and effort into a stock of these devices, which today he can. And I think you will agree with me that the store of the contractor-dealer today is one that is worthy and has a place in the business world.

A woman coming into the store to buy a lamp doubtless sees numerous devices that she is interested in. She makes inquiries. We take particular pains to see that our sales people are posted on all of the devices. She can get accurate information regarding any device she may see, and while she may not purchase that device when she has in mind the purchase of a lamp, the seed is planted in her mind that there is such a device and eventually she purchases it.

With the support, good will and confidence of the central stations throughout the Pacific Coast section we can show that we are on a firm business foundation, that we are capable of carrying on the merchandising end of the business, and I hope that some means will be arrived at, as suggested by Mr. Alvord, whereby the central station, the manufacturer, and the jobber and dealer can get together or some real publicity campaign which will be of benefit to everybody concerned.

As far as the bonus proposition that was put into effect by the Pacific Gas & Electric Company is concerned, the dealers unanimously voted that they did not care for the fifty cents per socket device that was sold; they would be more than glad to take that fifty cents and put it in a fund, and if necessary, add another twenty-five cents from their own pocket so they could have a fund that would be worth while, and a great publicity campaign could be carried on under the auspices of the Pacific Gas & Electric Company, who, at that time, were the only ones putting such a bonus campaign in effect.

C. F. Butte: The whole question simmers down to four things; education, enthusiasm, publicity and co-operation.

The story of the five-year-old child is somewhat opportune. The contractor and dealer is the five-year-old child. The five cents is the merchandising problem in the profits derived from the merchandise and materials. Father is the central station man, and in the past has held the merchandising of materials and has not given the dealer the opportunity to earn the profits. The contractor-dealer is using the method of the five-year-old child in getting the five cents. Father will say today, "No, you can't have five cents." He will tell the child tomorrow, you can't have five cents, but that child will get the five cents even if he has to put his arms around your neck when you are sitting in your rocking chair and kiss you on your lips and say, "Pa, let me have five cents, please, dear." And he will get it. (Applause.)

The contractor-dealer has been educated to the point of knowing how to ask for the five cents, keep it and spend it. The process of education has been going on for the last ten years, and we have reached the point of knowing how to merchandise.

The enthusiasm and interest shown in the contractors' car in the special train from San Francisco was not merely getting 28 hours out of 24 for the purpose of enjoyment. There were problems discussed that could not have been discussed under any other conditions, as we had central station representatives, jobbers, manufacturers, and contractor-dealers aboard in good number. We could not get away from one another, and we had to sit there and discuss the problems. We have thoroughly demonstrated in this convention that we mean business, we are enthusiastic, and that we have interest, and we cannot maintain any of them unless we have some money to spend to keep it up.

The publicity: I think you can't deny the fact that every contractor and dealer depends absolutely on what he sells Whether it is in the shape of appliances or whether it is in the shape of material installed, it is merchandise. We have three to four thousand individuals interested in that one problem. We have possibly thirty or forty thousand directly dependent upon the profit from the sale of merchandise. The central station, on the other hand, is interested in selling the appliances not for the profit in the merchandise, but for the profit in the consumption of the current that that merchandise will use.

We therefore ask that the central station maintain a legitimate price in the selling of electrical appliances,—a price based on the first cost plus the overhead expense plus a fair return on the investment. In return for the maintenance of a legitimate selling price we will be in a position to advertise, introduce and develop the use of electrical appliances, capitalize the publicity that can be had from thirty or forty thousand individuals, direct our efforts to mutual advantage and aid in the formation of public opinion. Is there any limitation to the benefits the central stations can have and can get, if we have three or four thousand successful contractors and dealers?

The contractors can help build good will for the central station. The contractor-dealer is daily meeting all classes of consumers and prospects, daily meeting problems never brought before the central stations, daily coming in personal contact with the consuming public and can lend material assistance towards the formation of public opinion and good will. However, it must be borne in mind that the contractor dealers must be met by the central station not as an aggressive competitor in selling apparatus or material but as an institution doing business in all its branches on business lines.

K. E. Van Kuran (contributed): A number of central stations have been marketing appliances at a reduced price. the chief reason being that it was necessary to make a special price to introduce these appliances in the homes of the consumers. We have carefully checked this problem and find that from our experience in central station campaigns that as many appliances can be sold at the retail price as at a reduced or special figure. This experience is borne out by campaigns which we have run in Denver, in some of our Pacific Coast cities, and in a large number of cities in the East. We do, however, believe that some form of time payments is of a great deal of assistance in putting appliances on the lines of the central station, but that reduced prices do not tend to appreciation of quality in appliances. Mr. Childs, in his paper, stated that the special prices are necessary in order to interest the consumer in the initial purchase and to dispose of a sufficient quantity to establish the lamp socket appliance as a permanent household necessity. We believe that the time payment is of a great deal of assistance in such work, but that the reduced price is not necessary and that as many appliances will be sold as at the cut price. We believe further that the higher price means a larger margin to the central station to permit of the employment of scientifically trained and well organized salesmen to sell this apparatus and that the resultant load on the lines of the central staton will be increased by such action. Further, that while the central station will increase the load on their lines by this method, they will at the same time sell at the same price as the dealer or contractor, and again enable him to sell more and more lamp socket appliances.

H. C. Reid: I am another one of the contractors from San Francisco. (Applause.) We accepted with a great deal of pleasure the invitation to become associate members in your organization, and consequently are here today, sitting in your meeting, studying and thinking about your problems, presenting to you some of our problems, and asking that when this convention breaks up and you go back to your respective businesses, that you will remember the contractor-dealer, and at the next annual convention we will have solutions to present and reports to make to show that the subject has been well thought of and well handled.

Mr. Bibbins said that we are the nerves in the finger tips of the industry. And I think you will all readily appreciate that we are the ones that go out, we meet the public in the highways and the by-ways, in ways that possibly the

central station representative does not meet it. We are the ones who help mould the opinion of the architect, and the engineer, and the prospective home builder. We help to stimulate your growth and your use of electricity in that manner, even though we do not have nice show windows on the main streets of your city, even though our office may be in an office building, still we are helping to mould public opinion, which is all for the betterment and the increase of the electrical industry.

We all appreciate immensely the privilege of being here with you today; that we are going to take back with us and distribute in our association meetings the problem of the extension of the electrical industry, the further co-operation with you central station men. I thank you. (Applause.)

Chairman: Gentlemen—Mr. Halloran has a few direct conclusions on this subject of merchandising. He has given the subject of co-operative merchandising a great deal of study over a number of years. He has not heard the discussion this morning, and does not know in reading his paper that his suggestions and conclusions are in direct line with our discussions. I know you will be interested in hearing what Mr. Halloran has to suggest as the definite beginning of the solution of this problem.

A. H. Halloran: The following plan for co-operative merchandising by the central stations and the dealers is submitted as a practical means for bringing the results suggested in the commercial committee's report and as a satisfactory solution for both parties to the arrangement. It is based upon the thought that each dealer should be constituted an accredited representative of the central station in his territory, and yet be independent in conducting his own business. It carries the further intention that the central station should control the sale of all appliances that go on its lines. It is somewhat the same plan as that whereby the drug store acts as a sub-postoffice, with the exception that while the druggist received no direct profit from the sale of stamps, the dealer will make not only the regular profit from the sale of electrical devices, but will also receive on each device further assistance from the central station in proportion to his value to the central station.

The idea is to intensively localize the central station's sales efforts,—to bring the electric power company to each consumer in his own neighborhood, instead of the consumer's having to go to the electrical company's central office. Let the dealer be authorized to receipt bills, receive and transmit, but not adjust complaints, sign contracts for electric service and perform other functions of commercial agents.

Let the personal solicitation for appliance business, the personal letters, the newspaper advertising, the circulars and the show window and store demonstrations be carried on jointly in the names of the dealer and the central station, but under strict central station supervision.

For the intelligent prosecution of this plan, a central bureau will be necessary to plan campaigns, prepare or procure booklets and circulars, advise on window and store display, write advertisements, and educate and train salesmen, supplying competent help to the dealers as needed. A large part of this task has already been anticipated by the commercial section N. E. L. A. and the Society for Electrical Development, but even their literature and campaigns should be adapted for local use and supplemented by a knowledge of the peculiar conditions of this territory.

This bureau service should be at the disposal of central station members who conduct their own merchandising campaigns, as well as such dealers as may qualify.

To qualify as a licensed dealer, a firm should be a member of a recognized association of electrical contractors and dealers. Such an association should include in its membership not only electrical contractors, but also hardware men, department stores, drug stores and any other establishments selling electrical appliances. Within a year's time every dealer's salesmen should have satisfactorily completed a course in electrical salesmanship and only such salespeople as can show a certificate to this effect should be employed by licensed dealers, to sell electrical appliances.

The details of this plan, as thus roughly outlined, should be worked out by the commercial committee of this section. It should determine the character of assistance from the central stations, the means for reporting sales and collections, the proper field and office men to organize and conduct the campaign, the specific qualifications of licensed dealers and the amount of money needed from central stations and jobbers to effectively and economically carry on the work for the next year.

This plan is submitted in the hope that it will start discussion and action which will ultimately put more business on the central station's lines, provide sufficient incentive for greater activity by the dealers and ultimately bring about better public relations, when every man in the electrical industry is working toward a common purpose, "each for all and all for each."

(An adjournment was thereupon taken until afternoon).

Chairman: I think Mr. Bennett of San Francisco, contractor and dealer, has prepared a paper or has some discussion prepared that he would like to bring out at this time. Mr. Tom Bennett.

T. J. Bennett: I am satisfied that after our arguments this morning, we have convinced the central stations that they should not be in the business of retailing heating devices.

Now, I am going to talk from the contractors' standpoint. It is my candid opinion that the financial efficiency experts of public service corporations are very lax. They are giving away something for nothing. They should arrange a definite distinction between the work done by the contractor and that done by the power company. I have the services particularly in mind. The underground service should stop at the bulk-head; an overhead service should be brought to the conduit that is installed on the outside of the building, and a pole riser service should be brought to the secondary arm and no further. In San Francisco there are buildings with three or four thousand dollars' worth of unused feeds and services in the basement. Some buildings have services from three companies while only one is actually supplying current.

Such a definite distinction would not limit the installations nor increase the cost, but the property owner would pay for it. The architects would be informed by a central station representative. "Here is our service point, here is where we stop; that is where the electrical contractor begins." The water companies have a place to stop. A plumber figures a job to the curb line.

The contractors can do this work more reasonably than the companies. The companies should not be in the contracting business, which requires the individual attention of the contractor. I have never seen an electrical contractor yet who could leave his business to somebody else and have it attended to. It is a business, a business all in itself, and I don't see how these service corporations can afford to do that kind of work.

As to the ranges, there has been a great deal of argument as to who shall sell and install the range wiring. As far as any contractor is concerned, we don't care who sells the ranges, but I really think we should do the wiring for the ranges. Many times the companies have said that they would sell the ranges and would give a portion of the installation price. Now, I think that if they went to the consumer in a different way, they could do more business; that is, by going to him and telling him that if he wires his house for a range according to the lines that are necessary, they would give him a range for nothing. It practically amounts to the same thing. I think they would sell a good many more ranges.

The central stations have also brought out the point that the contractor does not pay attention to the business when he secures a range installation. I do think that the central stations have not gone into this matter far enough. If they gave an order to a contractor who did not attend to it within four or five days, he is not an electrical contractor. Any contractor in San Francisco would start a job in a couple of hours. I think if the company would look into it, they would find they were waiting four or five days for the general routine of procedure to go through the company in order that they might get the necessary order to go ahead and do this job.

If the central station gave the contractor all work inside of the building they not only would get out of installing this work, but could also cut down their crew and equipment. The contractor could do that work better and make some money out of it. But, as I say, they are giving it away. I would like to see this proposition brought up before the efficiency committee to make a definite ruling on this subject, a report made and that the contractors be consulted on the proposition.

Chairman: I think that while the points brought out by Mr. Bennett are pertinent in our general discussion of commercial problems, they hardly really take the place in the discussion of the merchandising in the sense we have been discussing Mr. Childs' paper.

Mr. Bennett, I think, the points you have raised are possibly more local. I believe that if a committee of your local section in San Francisco, for instance, would put them up to the companies interested in San Francisco, you would get along further and possibly faster than by discussing it before the convention here.

C. H. Paulin: The question of wiring or the installing of the electric range by the electrical contractor has been raised several times. There is a question in my mind as to whether or not this is the proper method of handling this "at the present time." Understand me, I emphasize the "present time." This is on account of the fact that the outlying districts not within the city limits of any town, do not have an inspection system other than that of the central stations themselves. I have in mind several instances of where faulty installations were made and it became necessary to tear them out and do the work over. In one particular case wiring was in conduit, and partially underground work.

It is my opinion therefore that at the present time this work should be done by the central stations. Understand I lay emphasis on my former statement "at the present time." I am not prepared to state whether or not the central station should continue this policy indefinitely or not.

Since the electric range is at the present time in its infancy, I believe it behooves us all to see that every installation is made as near as possible an ideal installation, one that assists in making the electric range stick. All this for the reason that the future of the electric range depends absolutely on the number of successful installations we put in at the present time.

John A. Britton: Mr. Chairman and gentlemen—I think a word might be said in reply to the contractors with respect to the interference with their work, and their profit necessarily, by the distributing companies. You have to go back a little in history to really comprehend just why the power companies are undertaking to do the work they are doing now. None of them are doing it because they want to do it, or because they believe they can do it any better than the contractor, but it becomes absolutely an economic question which, from the very first inception of the introduction of appliances for any purposes other than lighting, going back to the gas game, became necessary when gas stoves were first introduced,—that is not so very long ago, either. The company had to take the initiative in all matters of merchandising and of connections, from the economic standpoint of the distributing company, to be sure that the service it is giving will be responsible and reliable.

When the electric appliances first began to attract notice, —that is not so very long ago, either,—the same conditions arose. You can't provoke a disposition on the part of consumers to use your commodity unless you will do as any other merchandising firm will do, make it easy for the consumer to get it, and the greatest deterrent today, and the greatest deterrent we have had in all of our experience, has been the cost.

It became essential in the introduction of gas stoves to give away gas stoves to consumers, do all the piping free of charge, and to make a differential in the rate between lighting and the use of gas for cooking purposes. Even with all of that, it became a difficult thing to displace the then existing appliances for the purposes for which gas was applicable, and that is identically true today in electrical appliances. The consumer is suspicious of the first cost; he is suspicious always of what it is going to cost him afterwards, and he is suspicious of the service he is going to get.

The power companies, in my judgment, are justified in every respect in adhering to their rule generally that they must install these appliances, because the average contractor does not do his work properly. I speak from the heart. We have contractors who do, who have respect for their positions, and respect for the patrons with whom they deal. But the average electrical contractor has not become a stable quantity in our community until very lately, and is not yet very responsible. The burden is upon the power company the moment the installation is made. The contractor, when he gets his money, is through with this trouble. We have to follow up every day and every night the complaints of the consumers, and it behooves us to see that the installation is so made that we can guarantee the service we are responsible for.

Now, I take it that the merchandising of appliances and creating and provoking additional sales is just as much a part the business of the electric company as is the generation and the distribution of the energy it supplies. I can't draw the line between the two. I am mindful of the responsibilities on contractors, and their investment of capital, and their desire to do work and to make their profit upon it, but I can't draw the line between them and ourselves when we have the demand for the service and the responsibility for it afterwards. We made no headway at all in trying to introduce electrical appliances, and we would have made no headway until we did actively do the work that we were required to do, for this reason, to go back to the principal and fundamental principle of it. That is the economic condition.

If we were to charge a consumer desiring an electric range the price of the range, plus the overhead and the profit that a contractor usually makes on the sales of his appliances, and charge him then with the cost of connection, we would not have any electric ranges in use. Nothing would kill that game more readily and more easily than to leave the question of the sale of the range and its connection to contractors. We can afford to do it for the resultant profit that comes to us in the end. We can't afford to do it as simply an immediate proposition, any more than we can afford to advertise, as we do in our company, to the extent probably of a hundred thousand dollars a year, and we can't do it any more than we can afford to do other things we do if it were not for what the future will bring the company.

The time will come when the contractor will find his appliance business is on an economic basis. And if we can require the contractors to give the most effective service to us, you will find the power men perfectly willing to turn over to the contractor all that belongs to him.

I believe, to touch upon the other point that was spoken of by Mr. Bennett, that there ought to be a line drawn where

the power companies will not invade the consumer's premises, but you have to accept the condition as it is, gentlemen. We are in very severe competition in practically all of our territory, with the exception of a few small towns where competition would not pay, and I do not think we can help doing the things we are now required to do, because if we do not, we will lose the business, and I am not sure that any arrangement could be made as between competing companies as to where they would agree to any such thing. If they could, as Mr. Walton well suggested, that is a local matter that ought to be taken up with the managers of the competing companies in the districts involved and see if that particular point can't be settled. We are deprecating very strongly in my company the putting in of any electrical apparatus in the consumer's premises. In places where we have no competition, I will not allow it. But I can't sit by and see business go to the other companies. So that becomes purely local.

Now, as to the question of merchandising, I believe so far as the power companies are concerned, they are the natural avenue by which merchandising should be done to the consumer. But in saying that, I don't want to dismiss the dealer and contractor. I believe there is a middle ground where the power companies, anxious to protect themselves, can deal with the dealer and contractor and give him an opportunity of doing business under our direction. I think we are approaching that point very rapidly. I think the dealers and contractors in our districts will agree that help in the last year or more has been given to them such as they have never expected to be given. Some of our plans did not work out, as the contractors and dealers and jobbers here know. I think I would not limit the bonuses, but would give aid in every respect to the dealers and contractors to help them get the business, and intend to still further increase that aid as far as I am personally concerned.

But I can't help but say again to emphasize that, that all of these matters of merchandising, as between the dealer and contractor and the power company, are altogether of a local nature. I do not see how the several companies here associated could sit down together and agree upon a policy. I am sure I would not try to dictate to Albuquerque, Phoenix, or Seattle. I don't think the dealers and contractors would expect an organization of this kind to undertake that kind of work.

But I do believe that with the spirit that pervades the power companies today, that the dealers and contractors, if they don't want too much out of the game, can make arrangements with the local concerns to meet them more than half way so they will get what rightfully belongs to them. And I hope and expect that all of the member companies will receive that same character of co-operaton from contractors that we are getting in our districts. I realize all of this little turmoil of differences as between ourselves could be eradicated if Mr. Bennett and Mr. Butte would agree to get Mr. Briggs or Mr. Fleishacker to sit down with me in my office, and we could probably decide that question in a half an hour. But I am not going to initiate it and Mr. Briggs is not going to initiate it. We are bound by rules and regulations, and we are bound to protect the investments put in our charge, to make money for the stockholders. I think we are making it legitimately.

We are not trying to force anybody out of business; that is a false idea, and the sooner the contractor gets that out of his mind, the better it will be, because we don't do in that respect any differently from what any other merchandising concern does. They all give things away. Why, I was at a banquet the other night attended by 350 manufacturers where they gave away goods of their own manufacture representing at least a total of two or three thousand dollars.

Now, if we have to get the business we are striving for, to make business better and stronger every day, we have to give those things away from time to time. We have to sell things below cost to encourage their use, because the greater development we make of the useful things that come into our business, the better in the future will be the demand on you for that business, because we have paved the way and ironed out all the difficulties in your business, and you are the ones that are going to benefit and not ourselves. Thank you. (Applause.)

H. P. Stow: My understanding is that the central stations do not want this business, that they have been forced into it as a protection to themselves. The manufacturer of anything does not want to retail it; he wants to wholesale it. And to my mind, the central stations simply are manufacturers. They are just a branch of the manufacturing part of the industry. The electrical contractors and dealers appear to be one and the same thing, and they are the salesmen.

The salesman, I find, in a mercantile business, thinks he is the most important man in the business. Everybody else does not agree with him; personally, I do. I think the salesman is the fellow that is bringing in the almighty dollar, and that is what we are all after; he is the fellow that brings the jingle into the pocket, and it seems to me that the contractors and dealers are the men who do the selling. My attitude towards the salesman is not that he is the finger tips of the industry, but that he is the heart of the industry, and I make the salesman believe it, and I put him up on a pedestal. He is not an overhead from my standpoint; he is a producer; he produces the most important part of the work of any industry; he sells the goods.

I have gone down through this country, talking to the dealers that deal in my class of goods, lighting fixtures, and in all of the towns they are also dealers in electrical appliances, and there are the contractors that go out and wire the houses, and so on. Whenever I have found a high class electrical contractor and dealer, I have found that he is getting the support of the central station. He frequently is a man that has worked as a lineman. They have tried him out and know he is a good man, and they are giving him all of this selling business. I think that is where it belongs. I don't believe that Mr. Butte and Mr. Bennett will have any trouble to get in touch with Mr. Britton in San Francisco, or any of you who come in contact with his company. I don't believe you will have any trouble if you can show him that you will play the game fair and square, and get all the help and all the assistance that you require.

I might say one word about conventions of this character. They represent the brains of the body. They start the ideas going and they bring men together, in order to swap ideas and I say make of a competitor a friend. Tell him your troubles, and go further and tell him your secrets; get his confidence, and he will tell you his troubles and tell you his secrets. You will find that he knows your secrets already, so you might just as well own up and tell them to him. He will help you solve your problems. I think that the oftener you meet and the more you discuss these things, in spite of the chairman, bring it out even though you do get off the subject of commercialism a little bit. You are going to be benefitted by such discussions. You have had statements made to you by Mr. Britton that were not exactly commercialism, but it is going to help you all, and eventually it is going to help him.

S. M. Kennedy: I might say a word or two on this subject if I had the opportunity. Mr. Stow has just referred to telling each other our secrets, and he has given a good reason therefor. However, there is one matter that I have not heard touched on, and that I would like to bring out from the standpoint of what I know in reference to the desires of some of the larger electric companies.

The companies represented here are not what we call philanthropists; that is, not when you get down to close quarters. We may be public utilities and have a desire to serve the public, but we must also protect and serve our stockholders. Now, there is a burden put upon those who have charge of the electric companies to develop their busi-

ness. There is a responsibility in connection with that development which means that we must get out of every dollar of investment as big a return as we are allowed to earn. If we don't exert ourselves, if we don't keep at it all the time, if we don't follow up every groove and work every channel, we are not doing our duty. We are not doing our duty to our selves, that is, to the company, to our stockholders, or to our consumers, and that means also to the contractor and to the jobber.

Now, the particular secret I want to tell you today, and I am speaking now particularly to the jobbers and contractors, is that in my opinion all that the central station should have to do with its customers—I say should have to do—is in the way of making collections, collecting money for service rendered. We do not want to be bothered with the work of collecting money for wiring, for appliances, and for any other kind of service that can be done by anybody else. It is sometimes a difficult thing in dealing with our customers to get our own bills paid—I mean the bills for service—and often our customers will impose upon us if we are selling them appliances, or having them paying for installations of any kind, saying, "Oh well, we are paying you for the power bills, and we will have you let the other float along for a little while."

Now, we can't get along without money, we need the income, and if we are doing work in the ordinary way of selling appliances, it needs to be paid for. Consequently we are at a disadvantage in that respect, and for that one reason in particular I would like to see all of the contracting work, all of the selling of appliances, turned over to those who can handle it better. But we have this duty and we must live up to it. Mr. Britton has explained very forcibly what we can do, and he has stated some of the things we can't do. And I want to tell you that we are progressing. Some fifteen or sixteen years ago when I came into this business, my company was doing wiring. We used to buy fixtures from Mr. Day up in San Francisco; he was a manufacturer; and we used to sell those fixtures, and we used to have to collect for them. We also had other contracting work which we found it necessary to do—even regular house wiring. That day has passed. Then came along the electrical appliance business, and we found that would be a most valuable adjunct if we could get a load that might be developed by such appliances. We found that we needed that load in order to build up our system, in order to develop our load factors, and in order to be able to sell energy at lower prices so that you, the contractors, would benefit as well as ourselves, and that the public would more generally use electricity for lighting, heating and power purposes.

That stage has passed, and gradually—I am speaking now particularly of the Southern California Edison Company—we are dropping out of the appliance business. One of my assistants said to me the other day, "Mr. Kennedy, do you know our appliance sales have fallen off between two and three thousand appliances for the first three months of this year?" I said to him, "I am glad of it." Because I had learned from outside sources that the dealers and the contractors were selling more than ever before.

I find that we today do a certain amount of work in the development of the electric cooking business. It is new; it is experimental, as far as the wiring is concerned. We have had to change the method of installing to what we did in the first place. It is new, but while it is new, it wants to be done right, because as has been stated here in this meeting, if it is not done right, then the electric company is going to have an endless amount of trouble, and if it is not done right the consumer is going to be dissatisfied, and the good work that has been done may be all undone if the installation is not made along proper lines.

I want to tell you gentlemen that the electric companies, as a whole, are ready and willing to get out of the electric contracting and out of the appliance selling, and all that, if they could feel that the work is going to be done as well by other means. Now, I have felt that that time is coming. With reference to certain kinds of appliances, and installations, it has come and gone. Today, when we make motor sales for power installations in the country and in the cities, we don't bother about the motors; we don't do the installation unless it is in some localities where the contractors either are not available or do not do the right kind of work. We want to get rid of it. We are glad to sell power and let somebody else make the installation. Formerly we used to sell every motor ourselves, and make every installation. We are progressing and the time is coming that you contractors and dealers are looking for. But you must recognize that today we are helping you build up your business for the future, and if we don't break the ground, if we don't develop this particular business which is profitable to the companies, and equally profitable to the jobbers later on, nobody else would do it.

G. E. Arbogast: It seems to me that the central station constitutes the hub of the electrical industry and that the manufacturer and jobber really follow in the wake of the development created by the central station. Their combined and ultimate object is to reach the consumer, but in the attainment of their desire, they have overlooked the importance of the contractor and dealer. Heretofore they have considered him from the wiring standpoint only, which the central station was forced to give up years ago for economic reasons.

Dealers are often not given the consideration that merchants receive in other lines. There are many reasons perhaps why the average electrical contractor does not become a merchant. More often than not he graduates from the tool bag and is forced to enter upon his venture without adequate financial assistance. Should the central station give aid in this direction, or at least create an incentive through proper and close co-operation, the wiring contractor would develop rapidly into a merchant as well.

Did you ever seriously consider the fact that every community in the larger cities, has its electrical contractor who is not only able, but does, perform the service required of him in his line in that particular neighborhood. It is logical to assume therefore, that the majority of families residing in his vicinity are personal friends. We have been told that eventually the drug store, grocery store and the hardware store will distribute electrical appliances and lamps, due primarily to the fact that they are located in the residential districts, and therefore, in a position to satisfy the wants of the people on short demand. Would it not be better, from the standpoint of service to the public, as well as the central station, for the electrical contractor in each community to open a small store for the distribution of electrical appliances in connection with his contracting business?

Do the central stations realize the progress made by the electrical contractors and dealers throughout the Pacific Coast during the past few years? At the present time we are thoroughly organized in every state. In Southern California we have an organization of over fifty members, known as the Southern California Electrical Contractors and Dealers. Our work, which is along educational lines, is not only with the contractor and dealer, but we are endeavoring as well to educate the public in the uses of electricity. This is being accomplished in many ways; largely however, by preparing specifications and plans for the original wiring installations through the architect and builder, and by co-operative advertising on the part of the dealers.

We have also been successful along legislative lines which has resulted in the past year in the enactment by the city council of Los Angeles of a conduit ordinance which makes it necessary for all wiring within the city to be installed in rigid iron conduit. Also an ordinance of registration, which requires a deposit of $50 before a permit can be taken out for the installation of electrical work, whether it be installation of electrical wiring or fixtures. Both ordinances un-

doubtedly have important bearing on the business in Los Angeles. The first, will to a large extent raise the standard and character of the work done, and the second in a measure will define who shall do the work.

Before closing, allow me to impress upon you the importance of closer and broader co-operation on the part of the central station, manufacturer and jobber, with the electrical contractor and dealer, to the end that he may not only serve the public as an electrical contractor, but that of a merchant in distribution of goods and appliances as well.

J. W. Redpath: The general trend of the discussion seems to be along the line of co-operation and get-together for bigger and better work. It has just occurred to me that possibly in our haste before luncheon we overlooked one of the most important papers that has been presented to us, that presented by our secretary, Mr. Halloran, which has co-operation and united action for its keynote. In view of that, I wish to make a motion at this time, that that paper be referred to the commercial committee for its careful consideration, and such action as it may deem proper to take.

Chairman: You have heard the motion, gentlemen, and the second, that we refer the paper presented by Mr. Halloran just before lunch on the question of a closer working arrangement between the various elements of this meeting to a special committee. I think it proper that that should be referred to the commercial committee for such action as it deems advisable, for the reason that in the commercial committee we have already a working organization. With the approval of Mr. Ballard, I am going to appoint a special committee on resolutions to convey our resolutions to the resolutions committee. I appoint Mr. Childs, Mr. Somers and Mr. Butte. We will now give Mr. Childs a chance to conclude in closing the subject of merchandising that he has so ably handled.

A. W. Childs: It seems that everything has been said that could be said that is germane to the subject, and every objection or point that has been raised has been answered. I made a few notes from time to time as the discussion progressed, but later speakers fully answered the former ones and the slate is clean.

The full discussion that we have had must result in benefit to every interest that is represented at this convention. When Mr. Kennedy was speaking, during the first part of his talk, I thought our company might be going out of the appliance business in Southern California. And I believe we would probably have done so then and there had it not been for the matter of load building, as has been fully explained.

Now, the central stations cannot afford to turn over to others the important work of load building until it has been fully demonstrated to them that it is in capable hands, and for that reason, gentlemen, the question, as I see it, is up to you. You will get the full co-operation of the companies whether you deserve it or not, but you will not get all of the latitude you may desire until you merit it. You may rest assured, however, that you will get it as fast as you deserve it and earn it. (Applause.)

THE ELECTRIC VEHICLE AS A LOAD BUILDER

The General Electric Review commenting editorially recently on the electric vehicle as a load for the central station tersely summarizes the points as follows:

The desirability of the electric vehicle business to the central station lies in the fact that it is practically all off-peak long-hour service, with a load factor of 30 to 35 per cent in comparison with a probable 10 per cent load factor for the electric motor. The author seems to favor the car-mile system of electric service charges, as by this system the customer with a little observation can foretell within narrow limits his electric vehicle service bill month by month. The scale of charges may be expected to vary for different sections of the country, depending upon the items that make up the cost of power production such as local coal prices; and in some cases a careful record of this business for say one year may show the need for a revision of the scale. In order to make the system as serviceable as the kilowatt-hour system, it might be well for the power companies to provide rates for any standard battery in any standard vehicle, rather than to restrict the rates to a certain make of battery in certain makes of vehicles as is the practice at present.

COMMERCIAL ASPECTS OF LAMP EQUIPMENT

The commercial section of the National Electric Light Association through its sub-committee on commercial aspects of lamp equipment recommends that:

Where semi-indirect lighting fixtures are installed, the use of appliances in conjunction with this type of fixture becomes more difficult, and something to take care of this condition is needed. We would suggest that next year's committee, as well as member companies, work on the design of an indirect or semi-indirect lighting fixture with an outlet for the extension cord.

Several possible solutions have been presented which should be given consideration. It is possible to drill the bottom of the bowl and insert a receptacle. This has the disadvantage of casting a shadow on the semi-direct bowl, which is objectionable. Then the bowl might be fitted with a brass ring and the outlet placed in the ring, being concealed by some sort of ornament when not in use. Another idea is to make the bowl hook large enough to contain the receptacle.

The need for some such equipment is great since the use of appliances must be encouraged if the residence and apartment income is to be maintained, and it is to the interest of every central station to push this proposition.

Another good way to build up the central station load on the off-peak period is to promote all-night burning of porch lights. As an incentive to do this a special fixture combining a porch light and an illuminated house number is recommended.

A unit of this kind will make the house number easily distinguishable and at the same time clearly light up the porch and steps. The income to the central station is increased, the householder has the satisfaction of knowing that his house is easily found and also protected from prowlers, and the street lighting is improved by the addition of numerous small units.

Something has been done along this line, but there is still room for development and it is well worth the time of any central station to go into the matter and work up an acceptable unit.

Your committee would suggest that all available material be turned over to national headquarters, so that the incoming chairman can have access to it. This material would also serve as a source of information to central stations, which could get it by applying to the secretary of the association. Member companies should not hesitate to avail themselves of this service.

SHORT JOURNEYS IN PACIFIC LANDS

(The typhoon, the water spout and other natural phenomena are occurrences in the Far East that the American engineer must reckon with should he engage in transpacific business with our foreign neighbors. Here is a description of some of these things as observed by the editor of the Journal while on a recent tour of Pacific lands in the Far East in an endeavor to form an opinion as to the possible future commercial and engineering relattions these countries may play with engineers of the Pacific Coast.—The Editor.)

PHENOMENA IN ORIENTAL SEAS OF INTEREST TO THE ENGINEER

The American engineer who dares to cross the Pacific and engage in practice in the Far East meets with an abundance of natural phenomena, the laws and occurrence of which together with a study of the methods of lessening their baleful effects, become of prime importance.

It is the purpose of this article to call attention to some of these phenomena with the idea more of laying the seed for serious thought on the reader's part should occasion later demand its deep and complete analysis, rather than burden the reader too heavily with information of heavier sort at this time.

I shall narrate several experienecs as they happened to me while on a recent tour of the Orient and in this unconventional manner relate to the reader some of these new and strange phenomena of which many of us have at times read, but few experienced.

THE ISLAND OF FORMOSA

This island, three hundred miles in extent, owned by Japan as a prize of war taken from China, stretches in a north and south direction about midway between the main Japanese Islands and the Philippine Group. Ninety per cent of the world's supply of camphor is shipped from here. Its mineral wealth is very extensive and its prospects for sugar production exceedingly bright. The Japanese consider it their richest colonial possession. It is off the rugged east coast of this island that beautiful water spouts play and the terrific typhoon generates much of its destructive violence. It is only by the study of new and hitherto unencountered phenomena such as these that the American engineer can hope to successfully engage in engineering practice in the Far East.

The Typhoon

Of all the deadly and uncontrollable forces of nature which infect the seas of the Far East during certain months of the year, the typhoon is by far the most to be dreaded.

The costly and massive structures erected by the English at Hong Kong are not so much a monument to their love of expenditure their love of expenditure to acquire permanency in construction, as for a protection against the deadly typhoon.

The typhoon is no more nor less than a terrific gale which comes with such force and dash as to sweep all before it. Indeed, vessels in the harbor of Hong Kong, securely anchored, have faced about towards the typhoon with all the force and power of their driving apparatus under full swing, and still been dashed backwards dragging their anchors with them. Lives by the thousands are lost under the heavy and terrific strain of the typhoon. Hence the only safety of the ocean going vessel is to be in an unusually sequestered harbor or else put out to open sea. The vessel can stand the rolling of the high seas if only it can be directed away from the shoals and rocks.

The typhoon seems to be more frequent in occurrence during the months of July and August. Hardly a day passes at this period but somewhere in the area subject to their violence one is under way. The months of the year in which they may occur are well included as a rule in the adage at the tongue's end of everyone having business either upon or near the wind swept shores of the Orient:

"June—too soon
July—stand by
September—remember
October—all over."

On my return trip to Japan, when about one day out from Nagasaki, Japan, we experienced the first warnings of a severe typhoon. For some time previous the captain had received wireless messages from ships further south that were encountering it. Most all the typhoons originate about a thousand miles east of the Philippine Islands somewhere near the United States naval base and cable station known as the Island of Guam. The typhoon then usually travels westerly or northwesterly in direction.

Upon arriving at the harbor of Nagasaki, which is well protected, we enjoyed a comparatively quiet night. The next morning, however we noticed that all chairs and rigging were most securely lashed and it was not long before we knew the reason why. The suddeness with which the real typhoon arrives is certainly hair raising. The howling, the clattering, the driving are all indescribable. While one side of the ship is experiencing severe strain, the other side is comparatively quiet with a score of huddling cabin passengers out observing the sea to report to the more timid within.

On all sides on this particular occasion we could see its baleful effects. Fishing boats were smashed and lives lost with no one daring to lend aid. A tempting prize in the nature of a first class fishing boat was driven out of harbor with no one aboard. This caused a young Japanese to dive in to claim it. With all the power he could exert even in the sequestered harbor

of Nagasaki, he was unable to control its course in any manner and soon found himself a helpless clamorer for aid clinging to a friendly buoy which happened in his path. Lucky it was for him that the typhoon soon subsided sufficiently for aid from a near by tug boat to be given.

By noon we looked ashore and though the typhoon signal was still up to warn shipping in the harbor, nevertheless such a calm was then presenting itself that the captain of our boat determined to put to sea. It turned out, however, that this perfect stillness was caused by our being at that time in the center of the raging typhoon which is usually a great calm, and upon poking the nose of our vessel out to sea the captain soon determined for the safety of cargo and passengers to return to port for another day.

The next day as we journeyed up the Japanese coast evidence of the unrelentless devastation of the day before was to be seen on all sides. Sunken fishing boats and wreckage of every nature was visible everywhere. The captain of the steamer Mongolia distinguished himself by bringing his ship to a stop during the storm and rescuing fourteen Japanese from certain death, for which valiant service a public reception at Yokohama was tendered him on his homeward voyage where he received the thanks of the Emperor of Japan.

And so it is that the engineer who is to engage in construction work of any nature whatsoever in the Orient must familiarize himself with methods of protecting his engineering creations from the onslaught of the typhoon.

PROPOSED GIGANTIC ELECTRIFICATION IN SOUTH RUSSIA

Moscow capitalists are organizing a stock company to provide electric current for the operation of the coal and other mines and the metallurgical and miscellaneous manufacturing industries of South Russia. A capital of 150,000,000 rubles, equal at present exchange rates to about $42,850,000, is proposed for the beginning of operations. The plan embraces the erection in the Donets coal basin of three electric power stations of 75,000 horsepower capacity each. It is proposed to transmit power from these stations not only to the mines of this region but also to the industrial towns and villages and to separate industrial plants in the governments surrounding the Donets district. The intention is to provide current for the iron and manganese mines, the blast furnaces, rolling mills, machine and miscellaneous metallurgical works, salt works, factories, and the cities and towns of this section, which is one of the most important industrial regions of the country and seems destined to become the most important. A total consumption of power to the amount of 420,000,000 kilowatts is estimated for the proximate future, after the war. It is not expected that ground will be broken during hostilities.

SOUTH CHINA A MARKET FOR ELECTRIC PLANTS

The new electric light plant at Mengtsz, in Yunnan Province, was put in operaton in the summer of 1916. This town is the customs station on the line of railroad from Haiphong, in the French territory of Tonkin, to Yunna, the capital of the Province, which at present furnishes the latter with its only means of rapid transit to and from the outside world.

LINKING UP OF ELECTRICAL SYSTEMS IN ENGLAND

Recent circulars issued by the Board of Trade urging economy in the consumption of electricity and co-operative work in generating plants are responsible for the inception of a plan to connect the largest electrical systems in England and Scotland. The proposal is directly concerned with the thickly populated industrial centers in Lancashire, Cheshire and Yorkshire, although the systems of London and the south of Scotland are included as indispensable factors in the tentative scheme of intercommunication.

The Incorporated Association of Electric Power Companies and the Incorporated Municipal Electrical Association have appointed committees to investigate and report upon the feasibility of the proposed linking systems. The report of the Yorkshire committee is expected in the course of a few weeks; the Lancashire and Cheshire committees have already reported favorably for the adoption of the proposal.

It was estimated that the cost of intercommunication of the various groups of the undertaking in Lancashire and Cheshire would be £281,399 ($1,393,419), but that the saving in coal consumption alone—taking coal at 17s. 6d. ($4.25) per ton—would amount to £82,000 ($393,053) a year. However, as the present export value of coal is 45s. to 50s. ($10.94 to $12.16) per ton, the economy in reality would be greater.

With reference to the practicability of the system for Yorkshire, it is suggested that by linking up the cables of the Leeds, Bradford, Huddersfield and Morley municipalities with those of the Shipley District Council and the Yorkshire Electrical Power Company, a great deal of waste incurred when the machinery is run for light loads would be prevented, and on specified days and nights one or more of the plants could be stopped entirely.

The ownership and operation of electrical plants in the cities are usually vested in the municipal government or corporation, and any economies effected in the cost of production per unit would be reflected in a corresponding reduction in the price per unit consumed by the public.

Coincident with the publication of articles suggesting the connection of electrical systems, the Yorkshire Post published an article advocating the establishment of central power stations, or mammoth generating plants, near the principal collieries of the country, where in the process of carbonization the valuable by-products of coal would be carefully collected and the resultant gas used for the further generation of electricity or piped to the consumer. The greatest difficulty appears to be the lack of adequate water supplies in the principal coal fields, which would necessitate an additional outlay in providing the necessary water for cooling towers and similar usages. It is confidently stated that the saving effected by such a system of generating and distributing electricity would provide it to the consumer at a cost that would entirely obviate the economic waste and the smoke nuisance incident to the carbonization of volatile coals in homes as well as in factories.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(The installation of starting compensators has been the source of much confusion, especially in California, where the recently promulgated Utilization Safety Orders have now become effective. Here is a timely discussion that will prove most helpful to the contractor and dealer, who must understand how to solve this problem. This article discusses recent development along the line of proper installation of this class of apparatus. The author is power apparatus specialist for a well-known electrical supply house of the West.—The Editor.)

NOTES ON THE INSTALLATION OF STARTING COMPENSATORS

There seems to be more or less misunderstanding on the part of many electrical dealers and contractors, wiremen or others interested as to just how installations of starting compensators for polyphase motors shall be made to comply with the requirements of the Electrical Utilization Safety Orders issued by the California Accident Commission. The questions which seem to be brought up most frequently are those relating to the kinds of switches to be used with compensators, the conditions under which switches are required and in connection with the use of overload relays as a substitute for fuses.

The principal orders applying to such installations are as follows:

Order 747 (c) which provides that manually-controlled starters for motors shall be so designed and circuits so arranged that they will return automatically to the "off" or starting position upon failure of the energy supply, except where motors are under competent supervision and equivalent protection is otherwise provided.

Order 737 which provides for the disconnection of fusible cutouts before being refused, etc.

Order 740 which requires that in connection with certain circuits or under certain conditions switches with protected current carrying parts shall be used.

Order 736 which states that means shall be provided so that switches controlling motors can, when closing would cause a hazard, be locked in the open position and tagged to prevent careless closing.

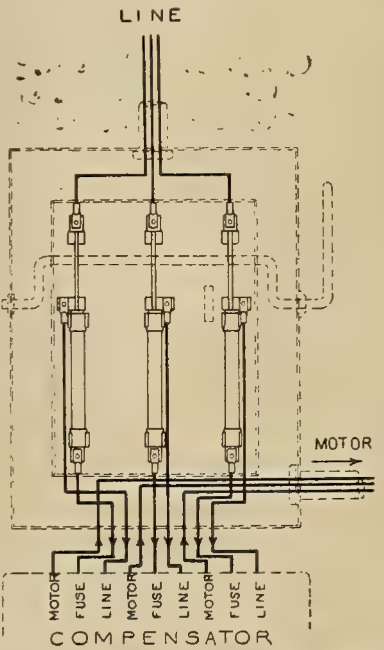
Order 703 covering grounding of apparatus.

In connection with new equipment we may eliminate a discussion of order 747 (c) since all modern compensators are equipped with mechanisms to give low-voltage protection, as required. However, it can be stated that the provision of low-voltage protective features on a controlling device is a most effective means of eliminating accidents since it prevents the unexpected re-starting of a motor or motor-driven machine after it has been shut down due to failure in power and after the line is again energized.

While all of the modern designs of compensators have low-voltage features and therefore comply with order 747 (c) as stated, none of them, to the writer's knowledge, meet the requirements of order 737 since even with the compensator handle in the "off" position the fuses at the compensator, also part of the contacts within the compensator, are alive unless there is a separate switch to completely disconnect these parts from the line. Removing the fuses does not help matters very much because even under these conditions the line contacts in the cutout and also part of the contacts within the compensator are still alive. Therefore, a switch is required immediately ahead of the compensator to completely disconnect it and the fuses from the line.

This switch may be non-fusible but should have a sufficient number of poles or blades to completely disconnect all wires of the circuit. In accordance with order 740 this switch shall have suitable casings or guards to protect the operator from danger of contact with the current-carrying parts, effective during ordinary operation. This requirement is best complied with by using enclosed, externally-controlled switches. The order is generally interpreted to mean a switch of this type. Further, as provided in order 736, this switch must be designed so that it may be locked in the "off" or open position when necessary.

When compensators are equipped with suitable overload relays instead of fuses for overload protection the line switch directly ahead of the compensator is not required. This is on the theory that a person



Connections for Compensator Installation

having sufficient knowledge to repair or adjust a compensator or its relays will also have judgment enough to know that the main or branch switch controlling this particular circuit should first be opened and therefore would not attempt to work on the live parts. This is no doubt a very safe assumption. Thus, a compensator equipped with relays will meet all the requirements noted provided it can be locked in the "off" position, as compensators are accepted as externally controlled devices. Very few of the compensators of

present designs have this feature but some form of lock can be readily applied to them. It is more than likely that many re-designed types of compensators will shortly appear on the market and no doubt all of them will fully comply with the orders herein noted and the "Safety First" idea in general. In the writer's opinion these new lines of compensators will have overload relays built as an integral part, while fusible types will be considered as sub-standard.

These orders also require that fusible cutouts shall be protected so that persons cannot come in contact with the current carrying parts; therefore, in addition to the line switch some sort of enclosing cover or casing must be provided for the fuses and cutout. The cover or casing must also carry a warning against removal of the fuses before the switch controlling the circuit is opened.

Installations of this kind can be very conveniently and easily made by using the new type compensator switches recently placed on the market by several manufacturers. In this device the line switch and compensator fuses are combined in one unit. These switches are of the single-throw, bottom-fused, enclosed, externally-controlled type and are identical in construction with standard switches of the corresponding type except that a lug is attached between the hinge jaws and upper fuse clip on each pole to receive the starting leads to the compensator as shown in the accompanying diagram.

When connected in this manner the fuses are not in the circuit during the starting period and therefore should be of the proper size to protect the motor during running. Ordinarily these fuses are selected to allow 25 per cent overload but, as pointed out in this department in the last issue of the Journal, fuses for 10 per cent overload will probably be recommended for the "50 degree" motors which will shortly be on the market. Fuses selected on either basis will also protect the motor against operating single-phase. In ordering switches of this type, the size must be selected according to the size of "running" fuses and not on the capacity of "starting" or branch circuit fuses.

The various orders herein noted do not require the use of externally-controlled switches except on circuits of over 150 volts to ground or when installed in damp places or where some local condition would entail a particular hazard, but as practically all polyphase motor installations involving a compensator come within these restrictions, the question of voltage has been purposely eliminated so far in this discussion.

It is a fact that very few polyphase motors larger than 5 h.p. are operated from 110 volt circuits, therefore, practically all polyphase motors operate at 220 or higher voltages. Even with one transformer grounded on the secondary side in accordance with usual practice for protection of lighting circuits, which are often supplied from the same transformers, the maximum voltage to ground is somewhat above 150 volts on 220 volt power circuits with standard connections ordinarily employed. The most common exception is the 4-wire 3-phase power circuit operating at 210 volts between outside conductors giving about 120 volts to ground with the neutral point grounded. Even in localities where these circuits are employed to some extent, the writer is informed that installations must be made as though the motors were operated on a 220 volt power circuit with over 150 volts to the ground. In general for all practical purposes it may be considered that all polyphase motor installations of 7½ h.p. and larger shall comply with the orders as herein outlined. This is assuming that all polyphase motors 7½ h.p. and larger will be started by compensators in accordance with the common practice for squirrel cage motors.

The question of grounding will not be discussed at this time as a general article on this subject will appear in this department in a later issue.

The information here given is based upon the writer's personal interpretation of the orders but is believed to be reasonably correct. However, when definite decisions regarding installations of this kind are needed it is well to take up the question with the inspector having jurisdiction in that particular locality.

CHANGING MOTORS FROM TWO TO THREE-PHASE OR VICE VERSA

Motors are often changed from two to three-phase or vice versa by reconnecting the windings. The results are usually not very satisfactory. This will be easily apparent by a brief study of the voltage relations in the two windings. Theoretically, there should be about 25 per cent more turns in a two-phase winding than in a three-phase winding for the same voltage. Hence, if a three-phase motor is reconnected for two-phase service at the same voltage, its performance will be the same as a motor operating at 25 per cent above voltage, which means its temperature would reach a dangerous limit in a very short time because of the increased exciting current. Conversely, if a two-phase motor is connected for three-phase at the same voltage its performance will be the same as a motor operating 20 per cent below normal voltage. By cutting out 20 per cent of the total coils the voltage across the remaining coils will be about normal. Even under these conditions the three-phase output will have to be reduced about 12.5 per cent below the original two-phase horsepower. This is because the full load current of a three-phase motor is about 12.5 per cent greater than the corresponding two-phase machine at the same voltage and if the horsepower is not reduced there would be increased heating due to the greater current density in the windings.

Still another method of adapting a two-phase motor to three-phase service is to use the T or Scott connection. In most windings this connection gives rise to unbalanced currents in the three-phases which effects the performance of the motor. The starting torque will be considerably less and the temperature rise much higher if the motor is loaded to its original two-phase capacity. The efficiency and power factor will also be poorer.

The change from two to three-phase is the most satisfactory of the two because the coils are not subjected to over voltage and will not overheat if the motor after being changed is not loaded to full capacity. Generally speaking, however, these changes are not to be recommended except under very favorable conditions. It is far better to rewind with regular three-phase coils and avoid trouble.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(A discussion of the character of electric pumping plants in their relation to power rates granted by large hydroelectric companies of the West presents a new view point for consideration by engineers throughout the West. Here is an article on this subject which cites instances from the practice of the San Joaquin Light & Power Corporation of California. The author is valuation engineer for this company and is unusually well qualified to speak authoritatively upon this important subject.—The Editor.)

USE OF POWER AND RATES FOR IRRIGATION PUMPING

BY G. R. KENNY

The San Joaquin Light & Power Corporation adopted the flat rate per horsepower of maximum demand per season rate in the beginning and has kept it in effect ever since. This rate has had the effect of inducing the consumer to put in a small installation and run it as nearly continuously as possible which has resulted in very high load factors and very low rates per kw.-hr. with consequent low cost per unit of water delivered.

In the neighborhood of 50 per cent of the installations are equipped with reservoirs which enable the consumer to pump 24 hours per day, and at the same time, have a large head of water for irrigation in daylight hours. The reservoirs are usually about 4 ft. deep and vary in size from about 90 ft. by 90 ft. to 200 ft. by 200 ft., the shape depending upon the location with respect to buildings, trees, etc. Many of them are three times as long as wide. The capacity is usually from 1 to 4 acre feet. They should hold sufficient water for 18 hours pumping. The method of construction generally followed is to scrape off the bottom of the site to form the reservoir walls. In the majority of cases, the reservoir holds water satisfactorily without any further treatment. If it does not, it must be either puddled or oiled. The oiling is generally entirely satisfactory, and oil can always be obtained, while suitable puddling material may be hard to secure. Concrete gives the best results but is too costly. The reservoir excavations cost from $50.00 to $100.00, and the oiling from $100.00 to $300.00, depending upon the size, kind of soil, distance that the oil must be hauled, etc. Water is used from the reservoir at a rate of from 300 to 400 miners' inches. This gives a very satisfactory head for irrigation, and an irrigation can be made with 25 per cent to 50 per cent less water than if a stream of 100 inches is used.

Some data from typical districts on acreage irrigated and cost of power per acre follow:

Table I.—Data on Irrigated Districts Served

	Alfalfa Territory	Citrus Fruit Territory
Acreage irrigated	22,893	9495
Horsepower used	1623.84	1470.75
Acres per horsepower	14.1	6.5
Average acres per h.p., all classes of crops.		10.5
Average costs per acre alfalfa territory...		$3 to $4
Average costs per acre fruit territory.....		$6 to $7
Average costs per acre all territory........		about $4.25

Practically all of the pumps in use are of the direct connected centrifugal type. For the deep well pumping, the turbine and plunger types of well pumps are installed. The pumping motors on the system vary in size from 3 h.p. to 75 h.p. only a very few being in excess of 15 h.p. while the average at the end of 1916 was 10.4 h.p.

There are several consumers who pump into ditches for distribution for a number of water users and it is in these cases that the larger sizes of motors are used. It now seems probable that this scheme may be followed in a number of other sections by the formation of irrigation districts, by organizing public utilities or in other ways.

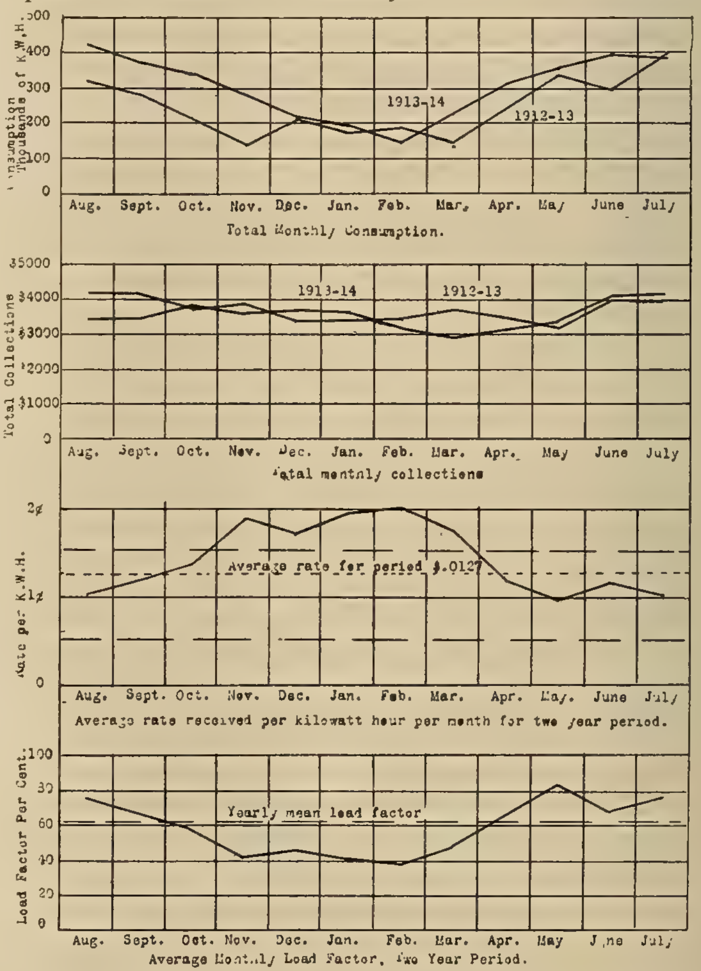


Fig. 1. Consumption, Collections, Rate per kw.-hr. and Load Factor for all $50 Flat Rate Consumers Served Continuously from August 1, 1912, to July 31, 1914

The rates provide for seasonal use for from three to twelve months, the average rate per h.p. per month decreasing as the length of the period increases. The present system of rates provides four distinct rates. A flat seasonal charge per h.p. of maximum demand, a flat seasonal charge per h.p. of connected load, equal to 94 per cent of the maximum demand charge per h.p. and demand and energy charge rates with the demand charge varying in the same manner as the flat rates above. If the consumer's maximum demand is approx-

imately the same as his connected load, he is given the connected load rate, and if not, he takes the maximum demand rate and his maximum demand is determined monthly by the use of maximum demand indicators permanently installed, or in some other manner. Much dissatisfaction has arisen since the maximum demand indicators have been installed due to the fact that they register the starting load on centrifugal pumps which averages 10 per cent in excess of the normal running load. The demand indicators are set for a fifteen minute period. Some recent tests indicate that a one hour average maximum demand at starting will give results averaging from 4 per cent to 5 per cent in excess of the regular pumping load. Prior to installing the maximum demand meters it was the company's custom to determine the maximum demand by tests taken at least once during each irrigation season. The rates based on the maximum demand are as follows:

Table II.—Rates Based on Maximum Demand

Months Continuous Service	Contract Flat Rates Rates per h.p.	Meter Rates: Meter Charge of $.005 per kw.-hr. Added to Following Demand Charges
3	$17.50	$10.40
4	21.55	12.50
5	25.15	14.30
6	28.50	15.95
7	31.65	17.45
8	34.55	18.85
9	37.35	20.10
10	40.00	21.30
11	42.55	22.40
12	45.00	23.45

The irrigation pumping business is necessarily seasonal, although many consumers find it advantageous to irrigate throughout the year. It is generally felt that winter irrigation is necessary for the best results with alfalfa. Citrus fruits are benefited by winter irrigation and the moisture in the soil prevents freezing if the temperature does not go too low.

The annual load factor of the irrigation business as a whole is low, but the load factors for individuals for their season, or for groups having the same season, is high. The diversity factor is low, as all the plants are run to capacity throughout the dry summer months.

The tabulation, Table 3, summarizes the results of a very careful study of the operating conditions of all irrigation consumers as shown by the records of their accounts for the period covered. The rates are those in effect prior to May 1, 1916.

Fig. 1 gives the average rate per kw.-hr, the average load factor by months, by years, and for the period for the 85 consumers who were served on the $50.00 per h.p. per year, flat rate, from August 1, 1912, to August 31, 1914. The average rate for 1912-13 was $.01342 and for 1913-14 $.01219 per kilowatt hour. The annual load factor in 1912-13 was 57.9 per cent and in 1913-14, 63.7 per cent.

Table IV.—Gasoline Pumping Plants and Irrigation Data Covering Gas Engines Operating in Territory Served by S. J. L. & P. Corporation, within One Mile of Power Line

Fresno District Only

	Average depth to water (feet)	18.4
	Used h.p. (per plant)	3.64
Classes of Irrigation:		
1.	Pumping out of ditch	30
	H.P. of same	161
	Average size of engine	5.4
	Acres per h.p.	5.9
	Hours run per plant per year	269
2.	Auxiliary to ditch	261
	H.P. of same	2682
	Average size of engine	10.3
	Acres per h.p.	4.2
	Hours run per plant per year	269
3.	No. of engines irrigating where no other water is used	224
	H.P. of same	1693
	Average size of engine	7.6
	Acres per h.p.	3.3
	Hours run per plant per year	322
	No. of irrigation engines that are used for domestic pumping	90

In order to determine the conditions of use of gas engines for irrigation, a survey of all gas engines operating within one mile of the company's lines was made in 1915. It was found that in general, the gas engines were used where but little irrigation was required, when water was pumped from ditches, or where water was needed to supplement ditch irrigation after the ditches had gone dry. The engines are generally run for only a short period each year. About 1200 engines were visited and the conclusion reached after the information obtained, was examined, was that in the majority of cases, the plants now pumping by gas engines could not be taken over for electric service to the advantage of either the consumer or the company. There are certain classes of power irrigation for which the gas engine, due to its low annual cost, if operated but little, may be used with considerable economy as compared with electric power. In table 4 the results of the survey of gas engines in the Fresno district are given.

Table III.—Summary of Data from Flat Rate Consumers' Accounts—Agricultural—January 1, 1912, to July 31, 1914

Kind of Contract: No. Mo. Operated per year	Kind of Contract: No. Hrs. Operated per day	Maximum Demand: H.P.—Latest	Maximum Demand: H.P.—Average	Connected Load—h.p.	No. Consumers	Av. h.p. per Consumer	Rate per h.p. per month	kw.-hr Used to Date	Amt. Collected to Date	Av. Rate per kw.-hr.	Load Factor: Annual Per Cent	Load Factor: Period
12	24	3171.17	3204.17	3707.00	344	10.80	4.167	18,539,753	246,871.13	.01331	57.2	57.2
12	Daylight	332.20	327.29	365.50	38	9.6	3.00	882,852	17,916.40	.01920	28.6	28.6
7	24	232.36	243.26	243.00	23	10.5	5.75	1,101,348	13,524.94	.01230	49.8	85.3
7	Daylight	86.71	86.50	85.00	10	8.5	4.14	201,858	4,816.45	.02380	17.2	59.06
6	24	253.44	255.58	273.50	29	9.43	6.25	731,572	15,428.74	.02130	22.6	45.2
6	Daylight	296.33	221.44	295.50	26	11.4	4.50	611,254	15,752.85	.0258	16.0	32.0
5	24	127.13	130.09	127.50	11	11.6	6.25	381,516	5,769.65	.0151	32.4	77.7
5	Daylight	225.95	224.41	239.50	21	11.7	4.50	255,993	6,803.40	.0266	12.9	31.0
4	24	142.53	145.20	153.50	18	8.5	6.25	438,222	8,012.25	.0183	20.9	62.7
4	Daylight	86.87	84.82	81.50	11	7.4	4.50	77,113	3,069.25	.0396	6.9	20.7
3	24	4.54	4.58	5.00	1	5.0	6.25	15,963	293.55	.0184	15.4	61.6
3	Daylight	24.27	23.66	25.00	2	12.50	5.50	33,362	776.45	.0233	10.8	43.2
Total flat rates,		4983.50	4951.00	5601.50	534	10.49	....	23,270,806	338,135.06	.01453	....	....
Colonization and Spec.		1244.08	1229.21	1456.50	113	12.88	....	1,969,411	42,098.02	.0213	....	....
Grand Totals		6227.58	6180.21	7058.00	647	10.91	....	25,240,217	380,233.08	.01506	....	....

FUEL OIL AND STEAM ENGINEERING

(How to accurately determine the moisture present in saturated steam is a useful and necessary adjunct to efficient steam engineering economy in fuel oil practice. In this discussion the authors first describe the types of calorimeter used for various degrees of moisture encountered and by citing carefully computed illustrations of their use, the reader is step by step led to follow the reasoning set forth in such a manner that a thorough grasp of this important subject should be attained by its careful perusal. The discussion concludes with details of corrections that should be applied and a recounting of the hints for the proper use of the various types of calorimeter to be employed.—The Editor.)

THE STEAM CALORIMETER AND ITS USE IN FUEL OIL PRACTICE

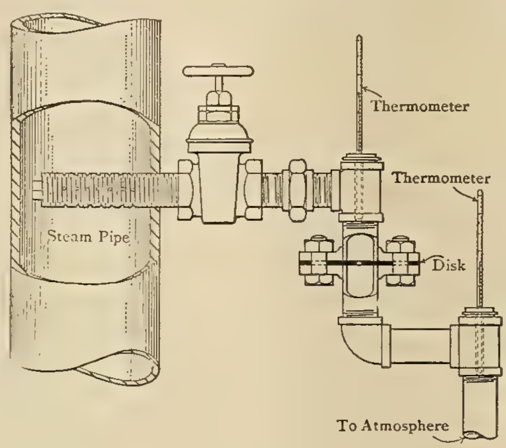
BY ROBERT SIBLEY AND CHAS. H. DELANY

We come now to a consideration of the methods used in steam engineering practice to accurately determine the moisture content of saturated steam. In the preceding chapter certain approximate methods were set forth, but in the following discussion it will be seen that by care and patience the moisture content of saturated steam may be ascertained with a wonderful degree of accuracy.

The Chemical Calorimeter.—The chemist has a method of determining the moisture content which finds little application in the steam engineering laboratory, but in the chemist's laboratory it is performed with a remarkable degree of accuracy. Certain salts absorb moisture held in a vapor. Hence by passing wet saturated steam over such salts, the moisture content is taken from the steam and by weighing the moisture so absorbed the degree of moisture held in suspension is ascertained.

The Throttling Calorimeter.—By reference to the steam tables it is seen that when saturated steam exists at say 200 lb. pressure per sq. in., each pound of steam represents a storage of heat equal to 1197.6 B.t.u. For it is seen from the steam tables that it took 354.4 B.t.u. to bring the original pound of water from 32° F. to its boiling point and then an additional 843.2 B.t.u. to evaporate this water into dry saturated steam.

Let us suppose for a minute this steam at 200 lb. per sq. in. were allowed to flow through an orifice and expand into a chamber which was at but 14.7 lb. per sq. in From the steam tables it is seen that saturated steam existing under such a pressure holds in storage but 1150.4 B.t.u. What then becomes of the difference between 1197.6 B.t.u. and 1150 B.t.u. represented by the heat held in storage in the two instances? Evidently if the main at the lower temperature be well hooded so that no heat escapes, the heat given out must go toward superheating the steam at the lower pressure. Since the specific heat of superheated steam at the lower pressure is about .47 the 47.2 B.t.u. that are liberated would evidently superheat the steam about 100°. The actual measurement, then, of this superheat gives us at once a most accurate method of determining the quantity of moisture present in the steam at the original pressure. For if we find that the steam is superheated only 25° F., instead of 100° F., evidently some of the mixture must have been water for otherwse its existence at the higher temperature as steam would aid in superheating still further the lower mixture.



THE THROTTLING CALORIMETER AND THE SAMPLING NOZZLE

In the typical throttling calorimeter, steam is drawn from a vertical main through the sampling nipple, then passed around the first thermometer cup, then through a one-eighth inch orifice in a disk between two flanges, and lastly around the second thermometer cup and to the atmosphere. Thermometers are inserted in the wells, which should be filled with mercury or heavy cylinder oil. Due to the fact that the heat content in the steam under the expanded condition with which it reaches the second thermometer, is much less, the heat thus liberated superheats the steam at this point and thus a means is given for ascertaining the moisture originally in the steam sample.

A throttling calorimeter, then, is simply a contrivance by which we allow steam to pass from its higher pressure through a small opening where its temperature and pressure are taken before it passes out into the atmosphere. Prior to its passage through the small opening, the temperature and pressure of the steam is noted. Let us denote by "s" subscripts the conditions of superheated steam in the low pressure chamber, "o" subscripts the steam in the steam main, and "3" subscripts saturated steam at the pressure of the low pressure chamber.

Each pound of wet saturated steam in the steam main has X_o parts by weight existing as dry steam. Hence the total heat represented in each pound of this steam is evidently $(X_o L_o + h_o)$ heat units as seen from close inspection. In the same manner each pound of steam in the lower pressure chamber holds in storage $[(H_3 + C_{pm}(t_s - t_3))]$ heat units as seen from previous reasoning. Since no heat is allowed to escape, evidently these expressions are equal one to the other, or

$$X_o L_o + h_o = H_3 + C_{pm}(t_s - t_3)$$

C_{pm} for the low pressures has a value of 0.47, hence, we have

$$X_o = \frac{H_3 + 0.47(t_s - t_3) - h_o}{L_o} = \frac{H_s - h_o}{L_o} \quad \dots (1)$$

in which H_s is the total heat of superheated steam in the low pressure chamber. Its numerical value may be taken directly from the steam tables when the pressure and degree of superheat are known.

As an illustration, let us assume that the pressure in the steam main is 153.6 lb.. per sq. in. abs. and that its temperature is found to be 362.9° F., thus indicating at once that the steam is saturated and not superheated. After it has expanded into the low pressure chamber it is found to have a temperature of 261.3° F. and a pressure of 14.8 lb. per sq. in. absolute.

From the steam tables we find $L_o = 859.6$; $h_o = 334.8$; $H_3 = 1150.5$; $t_s = 261.3$; $t_3 = 212.4°$ F.

$$\therefore X_o = \frac{1150.5 - 334.8 - .47\ (261.3 - 212.4)}{859.6} = .9758$$

Therefore the steam is evidently 97.58 per cent dry.

The Limitations of the Throttling Calorimeter.—A little consideration of the underlying principle of the throttling calorimeter brings to light a definite range of limitation to its usefulness. It will be remembered that this fundamental principle consists in liberating sufficient heat at the lower pressure not only to evaporate any moisture that may exist but to actually superheat the entire mixture. If there is not sufficient heat liberated, that is if too much water is held in suspension in the saturated steam, the steam at the lower pressure fails to become superheated and hence we have no means of measurement.

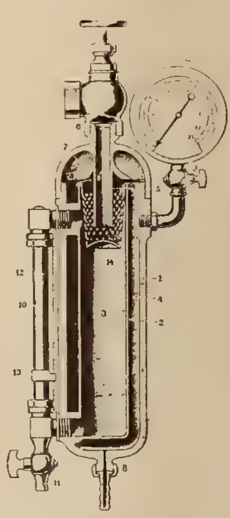
Thus if steam pass from 100 lb. absolute pressure per sq. in. to 30 lb. absolute pressure per sq. in., the total heat at the upper pressure is $(X_o L_o + h_o)$ which from the steam tables becomes $(X_o\ 888 + 298.3)$ heat units and that at the lower pressure is H_3, or 1163.9, if it be not at all superheated. Hence we have

$$X_o\ 888 + 298.3 = 1163.9$$

$$\therefore X_o = \frac{865.6}{888} = .9748$$

This means that if there is a greater moisture content than 2.52 per cent the steam calorimeter will fail to work because the mixture in the lower pressure space does not become superheated.

If instead of having the low pressure of 30 lb. absolute per square inch, the steam in the calorimeter had been throttled down to 14.7 lb. the value of H_3 would have been 1150.4 instead of 1163.9 so that X_o would become .9597 and the limit of the calorimeter in this case would be 4.03 per cent of moisture.



THE SEPARATING CALORIMETER

In this type of separating calorimeter the steam, with its moisture enters from the steam main at 6 and is forced to travel downward toward 3 at a high velocity. At 14, however, the direction is suddenly reversed upward toward 7 and later passes downward through 4 and out into the atmosphere at 8. When the sudden reversal takes place at 14, the moisture in the steam collects at 3 and its content is measured on the gauge 12. The steam content, on the other hand is calculated by means of Napier's formula as it passes through the orifice at 8 as illustrated in the text.

Again if instead of steam at 100 lb. absolute pressure we had steam at 200 lb. and allowed the sample in the calorimeter to be throttled down to 14.7 lb. it may be found in the same way that the limit of the calorimeter is 5.66 per cent of moisture. It is thus seen that the greater the difference in pressure between the high pressure and the low pressure in the calorimeter, the greater is the range of the calorimeter.

The Electric Calorimeter.—It is now evident that if a definitely measurable quantity of heat could be added to the steam before it was allowed to expand, even very wet steam might be accurately measured by the throttling calorimeter. This is seen at once when we analyze the total heats involved. If E_o be the heat units added to each pound of steam, then the total heat possessed by each pound of steam in the high pressure main is $(X_o L_o + h_o + E_o)$ heat units and since the heat in each pound of steam in the lower chamber is H_s, we have, since no heat escapes

$$X_o L_o + h_o + E_o = H_s$$

$$\therefore X_o = \frac{H_s - h_o - E_o}{L_o} \qquad (2)$$

In the Thomas electric meter an electrical mechanism has been invented whereby a series of small wires electrically heated impart a known quantity of electrical energy to the steam. This electrical energy dissipates itself as heat and since we can transfer electrical units into heat units and vice versa, a ready means is provided to assist the throttling calorimeter in doing its work by adding sufficient heat to widen the range of the throttling process.

Thus, although the throttling calorimeter was found definitely limited above as set forth, let us investigate a case where the electrical calorimeter may be used. Let us assume the upper pressure to be 200 lb. per sq. in. and the lower pressure 15.0 lb. per sq. in. In this case there were electrically added exactly 40 B.t.u. of energy and the temperature of superheat t_s was found to be 233.0° F., hence from the steam tables we find

$L° = 843.2$; $h_o = 354.9$; $t_s = 233.0$; hence, $H_s = 1160.1$

$$\therefore X_o = \frac{1160.1 - 354.9 - 40}{843.2} = 0.908$$

The Separating Calorimeter.—In the separating calorimeter the moisture is mechanically separated from the steam. If we know the total amount of steam passing and also the weight of the water separated from the steam, it is of course an easy problem to compute the dryness of the steam. Thus, if W_1 is

the weight of water separated per hour in the calorimeter and W_2 the weight of dry steam passing out of the calorimeter per hour, we have by inspection

$$X_0 = \frac{W_2}{W_1 + W_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Hence, if a separating calorimeter deposits 285 lb. of water per hour and if 10,000 lb. of dry saturated steam leave the calorimeter per hour, the dryness of the steam is

$$X_0 = \frac{10000}{10000 + 285} = 0.972$$

There are many principles upon which the separating calorimeter may operate. There are two forms, however, which are more usual than others. In one instance the steam mixture is given a rotary motion in its journey and consequently the water particles are thrown off by centrifugal force and collect in a drip below. In the other instance the stream flow receives a sudden reversal in direction. As dry steam easily performs this feat and water insists upon continuing its former direction of flow a separation is thus mechanically effected.

This type of instrument is not as accurate as the throttling type, as it does not get all the moisture out of the steam. When large quantities of moisture are present, however, it proves useful in taking out the bulk of the water or moisture while a throttling calorimeter connected in series later on accurately measures the remaining water content present. Thus by such a method of operation any degree of moisture present in steam is easily and accurately measured.

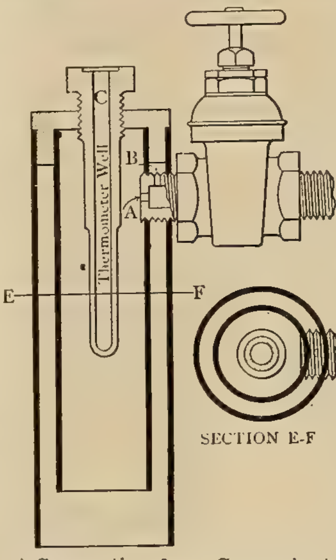
Correction for Steam Used by Calorimeter.—In a great many instances the total weight of steam passing per hour through the steam main under test is of prime importance. Since most forms of calorimeter operate by diverting a portion of this steam out into the atmosphere, it becomes necessary to have some quick and ready means of computing the quantity of steam so diverted.

Many years ago Napier deduced an approximate formula for the flow of steam into the atmosphere from a high pressure source. This formula is well within the degree of accuracy required for steam diverted through the calorimeter. If W is the pounds of steam flowing per second, p the pounds of pressure per square inch exerted by the steam in the main, and a the area of the orifice in square inches through which the steam passes, then

$$W = \frac{pa}{70} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Conclusions on Moisture Measuring Apparatus.—Summing up the arguments of this chapter we see that for comparatively small quantities of moisture present in steam, the throttling calorimeter is the most accurate device for its quantitative determination. If, however, large quantities of moisture are present, two methods present themselves. Either we must first remove the major portion of the moisture by means of a separating calorimeter and later determine the remaining moisture content by means of the throttling calorimeter, or we must add a definite quantity of heat to the original steam supply by means of a device such as the Thomas Electric calorimeter and then determine with proper computation factors the moisture present by means of the throttling calorimeter.

As already shown the throttling calorimeter may be used up to moisture of 4 per cent for steam at 100 lb. pressure and up to a little over 5 per cent for steam at 200 lb. pressure. Most boilers deliver steam containing not more than 1½ per cent or 2 per cent of moisture so that for nearly all ordinary work the throttling calorimeter has sufficient range, and owing to its great simplicity and remarkable accuracy it is almost universally used. It is possible to make up a throttling calorimeter by means of pipe fitting by providing a disc within a pair of flanges having a small hole to act as the throttling agent; or the throttling may be done merely by partially opening the valve on the sampling nipple close to the main steam pipe. An extremely convenient design of calorimeter and one that can be readily moved from place to place is shown in the illustration. In this design a steam jacket is provided to prevent, as far as possible radiation losses from the calorimeter. For many further useful pointers and detail rules in ascertaining the moisture content of steam the reader is referred to the latest edition of "Steam" by the Babcock & Wilcox Boiler Company, and to the report of the Power Test Committee of the American Society of Mechanical Engineers which is to be found in Vol. 37, transactions A. S. M. E. for 1915, to which publications we are indebted for much of the information contained in this discussion.



A Suggestion for a Convenient and Compact Type of Throttling Calorimeter

The Sampling Nipple.—The American Society of Mechanical Engineers recommends a sampling nozzle made of one-half inch iron pipe closed at the inner end and the interior portion perforated with not less than twenty one-eighth inch holes equally distributed from end to end and preferably drilled in irregular or spiral rows with the first hole not less than one-half inch from the wall of the pipe. The failure to determine an average sample of the steam is the principal source of error in steam calorimeter determinations.

The installation of large Diesel engines have increased remarkably during the past year, due to the general rise in the cost of all fuels and the need for more motive power in the expansion of our industries. Wherever hydroelectric power is available, however, its advent has not been nearly so marked as in other localities.

SPARKS—Current Facts, Figures and Fancy

(In spite of the fact that fuel oil is costly and that hydroelectric development is constantly expanding in various sections of the West, the steam auxiliary reserve of practically every large central station is being enlarged, so keen is the call for new power on all sides. Below will be found many interesting items of recent trend in steam auxiliary design as well as other items of general information for the reader.—The Editor.)

It is estimated that a total in excess of half a million horsepower of new water wheel capacity was installed in hydroelectric plants during the last calendar year.

* * *

Big central station steam auxiliary plants are fast drifting towards the utilization of 250 deg. Fahr. superheat and pressures of not less that 250 lb. Already a power plant on the Pacific Coast is being installed to utilize 275 lb. pressure.

* * *

Where formerly steam velocities of two to three thousand feet per minute were commonly met with, we now find velocities as high as seventy-five hundred feet per minute and certain authorities are advocating velocities in excess of ten thousand feet per minute.

* * *

Steam meters on each boiler are of value, not only because they enable the operator to judge furnace conditions and thus operate more economically, but because their use make it possible to deliver a greater gross output from the station, as underloaded boilers can be found and loaded up.

* * *

For many years California has been, and still is, producing from 70 per cent to 80 per cent of the quicksilver yield of the United States. This metal is absolutely essential from a military standpoint, as there has not yet been produced a commercial substitute for it in the manufacture of fulminating caps for explosives.

* * *

In spite of the fact that the states of Arizona, New Mexico, Nevada and California can boast but four million in population, there exists no other section of the country where electrical utilization has a wider diversity of application, where more meters are installed per inhabitant, or where lower rates for energy or more economical generating costs prevail.

* * *

In a city of the West of three hundred thousand inhabitants, eighty-seven offenders in 1916 contributed over a thousand dollars in all for thefts of electric power. In no other line is the thief as liable to be caught and have to pay the consequences as in the stealing of this product in spite of the fact that the stolen goods bear no visible manifestation for possible detection.

* * *

Rare metals are coming to the front. Nickel-steel and chrome-nickel-steel we know in armor plates, and for the wearing parts of ore-crushing machinery and manganese steel is another tough favorite, often used in burglar-proof safes. Molybdenum and tungsten, too, have come into use and it is said that the rims of the great German howitzers are made with molybdenum steel. Another metal, very like tungsten, brought out in working radium ores, is uranium, and there has been considerable discussion over it.

* * *

Quite a few orders have recently been placed for steam turbines of 35,000 kw. capacity. Not only are turbines increasing in size, but they are working under higher steam pressures. The larger units with higher steam pressures, give greatest economies of operation. It is believed to be entirely feasible to design commercial boilers for 500 to 600 lb. pressures.

* * *

As an instance of the part that the electrical industry is playing in backing the national government financially the case of the General Electric Company may well be cited. This company has subscribed five million dollars to the Liberty Loan and has perfected a plan whereby employes may arrange to buy bonds on installments, independently of its own subscription.

* * *

In the new chemical building at the University of California it is planned to install apparatus by which nitrogen can be liquified and even helium reduced to a temperature where it will liquify—that is, to a temperature of only two degrees above absolute zero—only two degrees above the point when heat ceases to exist. Experiments along these lines have shown that electrical resistance ceases when a temperature as low as that of liquid helium is reached, and that an electrical current set going in a ring of metal will continue for weeks, instead of being used up by resistance, as it is at higher temperatures. What a wonderful saving in transmission of hydroelectric enenrgy could be accomplished under such temperatures!

* * *

Users of electricity for lighting are informed in Circular 55 of the United States Bureau of Standards that the tungsten lamp has been improved in quality and reduced in price to such an extent that no customer can afford to use carbon lamps, even if he were paid a bonus on each lamp for so doing. The bureau has continued to give its earnest approval of a wider use of the tungsten lamps as a measure of economy. In condemning the useless consumption of current that is involved in the use of the old style of lamp the Bureau of Standards has considered the subject from the standpoint of each of the parties that are vitally interested—the users of lamps, the utilities that supply the current, and the state commissions and municipalities that regulate the utilities.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

The semi-annual index for Vol. XXXVIII, which is completed with this issue, will be sent upon request to any subscriber.

CO-OPERATION—NOT COMPETITION

In its last analysis competition means war and it ought to cease. To bring this about the development of the highest and truest spirit of co-operation attainable is absolutely essential. Let us remember, then, that co-operation in every human endeavor is the keynote of the hour. The spirit of co-operation and the spirit of the great West have ever been synonymous terms. Are you doing your part in missionary work to make this entire nation of ours one vast, throbbing, harmonious activity, whose foundation stone is democracy built upward from its broadminded citizenship by the all conquering spirit of co-operation?

Don't Economize but Synchronize

Frugal economy at the present stage of national affairs is foolhardy. Never were opportunities bigger or grander for the service of the nation and humanity than now. And in serving the nation and humanity the reflex action is bound to forward the financial status of the individual.

At the close of the civil war some said the proper solution of the negro problem was to send all the colored race back to Africa. Investigation showed that ships could not be built fast enough at that time to transport the negro babies being born, let alone return the adult population to its former abode. This country's wealth is now close to a quarter of a trillion dollars. The probabilities are, under the gigantic industrial and agricultural response of the nation to meet the world crisis that wealth is being created here at this present time faster than even the devastation of war can tear it down.

As an evidence of the confidence felt in affairs electrical, the recent happenings in Salt Lake City might well be cited as typical of activity in the West. After the declaration of war, in response to the president's message advocating increased industrial activity and efficiency, there was closed in Salt Lake City an electric sign contract calling for an expenditure of over ten thousand dollars, thus perfecting one of the largest single electrical sign contracts ever closed in the West.

When thoughtful men question in these days, their innermost feelings and emotions for guidance, the answer comes back that concerted effort which makes for true efficiency is the great need at present. That which tends to hoard finances or to hide the face in fear is intolerable. Extravagance and waste of every nature must be eliminated. Sane utilization of our resources is essential. Autocracy would endeavor to impell efficiency from above downward. Democracy breathes its activities from the human individual upward—free and unencompassed.

Let us put forth in the individual life of the nation more energy than ever before. And let us make this energy count for net returns. In a word—don't economize, but synchronize!

Prices for Governmental Supplies

There is much apprehension abroad as to the question of proper prices for governmental supplies. After all is said and done, true value is independent of fluctuation in market prices of gold or the cost of labor. In a word value is itself indestructible, unchangeable. The only difficulty that arises is to fix its proper relationship with the changing medium of exchange commonly known as the American Dollar, for value, like the hardy Flathead Indian of Montana, is never dismayed, never lost ("Injun no lost, tepee lost").

Much serious consideration should then be given at this time to the readjusting of this relationship and the suggestions offered in a recent issue of Collier's are most appropos.

A policy of low prices for supplies to the government would result in a crimped feeling, shrunken productions, a widespread spirit of discontent, lowering of wages in some lines causing intense feeling of unfairness, timidness on the part of capital, cessation of much development, retrenchment, and small if any war taxes. The government will buy supplies and raw material for other allied governments who in turn are known to be buying for private industries whereby we would be giving our foreign competitors an unfair advantage over American business.

Broad lines of constructive policy, which measure value according to its true worth will be one of the most helpful attitudes that can be assumed by those in responsible charge of the government.

Transformer Standardization

At the Riverside convention of the Pacific Coast Section, N. E. L. A., the report of the committee on standardization of transformers was not printed by request, owing to the desire that the National Society be allowed to present its report first.

Since this report has now been made, there will be found on another page of this issue a discussion of unusual interest to engineers and power companies throughout the West.

It is in the hope of improving manufacturing conditions, reducing costs and bettering deliveries that this standardization has been undertaken. Its results will be of great benefit. There are of course many conditions in the various systems where the standards adopted will not suit the conditions involved and it is not the intention that these recommendations shall in any way limit the use of special transformers.

The idea has been to standardize as much as possible and to give to the operating companies the results of quantity production that such standardization will bring about. It should be borne in mind that material benefit will accrue to the operating companies if logical standards are established and a conscientious effort made by all companies to encourage manufacture in keeping with the standards, and they therefore represent the ideal towards which to work in designing new systems and in making additions to or changes in existing systems.

The Electric Vehicle and the Truck

Recent informal discussion among men of the electrical industry throughout the West emphatically has brought out the fact that now is the opportune time to initiate a campaign that will produce far reaching effects in the more extended use of the electric truck and pleasure vehicle.

Those who have watched closely the evolution of the electric truck and pleasure vehicle during recent months and noted its constantly increasing popularity over certain of the fields of usefulness, hitherto evacuated under the terrific onslaught of the publicity campaign of the gas-operated car, have come to the inward conviction that throughout the West are to be found untold fields of usefulness for this activity of the electric manufacturer. Indeed immediate results await but the dissemination of these facts that are being daily brought to light.

A forceful instance of this lack of education and dissemination of recent accomplishments along these lines developed at the recent San Francisco Electrical Development and Jovian League. Among other interested men of the industry, one member, for so long a period known and beloved as the president of a well-known electrical supply house of the West, was asked to give his opinion of the electric truck and pleasure vehicle. The answer came quick and strong that while he was now the owner of seventy gas-operated cars, he reserved an electric car for his own individual pleasure and that in his former engagements in the electrical business the use of the electric truck proved beyond the question of a doubt to be far superior to the gas-operated car when dependability was to be taken into account.

The time has now come when the electrical industry itself demands the gathering together of facts that are being brought out in all districts of the West and that these facts be disseminated broadcast, for they will well bear the searchlight of investigation.

Some of the questions the business man wants to know from authoritative sources as brought out in recent discussions in the National Electric Light Association are the following:

"Are electric trucks used in any business like mine?"; "Who are some users that have proved the electric truck's value to themselves?"; "What sizes of electric trucks are made?"; "How much can they carry?"; "What size truck do I need in my business?"; "Who guarantees the operation of the batteries—the battery maker or the car maker?"; "What are upkeep costs compared with gas-car costs?"; "What are the operating costs compared with horse-drawn wagons?"; "How do I get the car charged?"; "What is the cost of a charging outfit?"; "Who will sell me a charging outfit."

Men of the electrical industry of the West must awaken to the necessity of collecting this information from this particular field—among the central stations, the universities—and disseminating it broadcast. And such bread cast upon the waters will surely return an hundred-fold in profitable sales by manufacturers and in the filling up of the valleys of central station loads throughout the West.

PERSONALS

A. A. Gray, general manager of the Electrical Review and Western Electrician, and **Chas. L. Benjamin**, formerly advertising manager of the Cutler-Hammer Manufacturing Company, have formed an alliance as counselors to technical and

trade advertisers under the firm name of Gray and Benjamin, with headquarters in Chicago. Few men have been more prominent in publishing and advertising circles during the past twenty years. The best wishes of the West go with them in their new venture.

E. T. Kavanagh, an electrical engineer at Mare Island, is a recent visitor at San Francisco.

E. J. Wallis, Pacific Coast manager Western Electric Company, has returned to San Francisco from Los Angeles.

J. S. MacPherson, general auditor of the Federal Sign System (electric), from Chicago, is a San Francisco visitor.

W. S. Berry, Pacific Coast sales manager Western Electric Company, is at Seattle, Wash., and expects to be at San Francisco on June 21st.

T. E. Bibbins, president of the Pacific States Electric Company, is expected to return to San Francisco from the East on June 15th.

B. A. Wagner, Pacific Coast manager Electric Agencies Company, has returned to San Francisco from an automobile trip to Los Angeles.

S. M. Kennedy, general agent and **A. N. Kemp**, comptroller of the Southern California Edison Company, are recent San Francisco visitors.

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, is making an extended trip through Oregon, Washington and Idaho.

J. W. Wooley, secretary of the Oshkosh Manufacturing Company of Oshkosh, Wis., manufacturers of electrical construction materials, is visiting Pacific Coast points.

I. R. Soloman, formerly Los Angeles manager, has been promoted to manager of traffic and sales for the Gould Storage Battery Company, with headquarters at San Francisco.

Fred D. Baker, new business manager with the Sierra & San Francisco Power Company, has been commissioned as captain and quartermaster in U. S. Officers' Reserve Corps.

R. T. Guppy, formerly associated with the electrical engineering staff of the Southern Pacific Co. at San Francisco, is now with the engineering staff of the Southern California Edison Company in its new development work near Ventura, California.

C. E. Stevens, manager illuminating section of the supply division of the Westinghouse Electric & Manufacturing Company, and **L. A. S. Wood**, special representative of the Geo. Cutler Company, have been in California, Oregon and Washington during the past two weeks.

Bayard W. Mendenhall, formerly sales manager of the Utah Power & Light Company and more recently a manufacturer of Electrical specialties at Salt Lake City has left the electrical field to assume the management of the Salt Lake branch of Miller-Cahoon Company's automobile selling and distributing business.

Chas. H. Delany of the Pacific Gas & Electric Company, **Gaskel S. Jacobs** of the California Railroad Commission, and **Chas. A. Watts** of the Great Western Chemical Company, are assisting the University of California Extension Division in leading classes on heating and ventilation for various groups of steam fitters in Central California.

C. R. Young has been appointed sales manager of the Pacific Power & Light Company with headquarters in the Portland office. Though a comparatively recent graduate of Stanford University, Mr. Young's promotion comes as no great surprise to his many friends who are familiar with his tireless energy and effective application to work.

Ludwig Kemper, formerly manager of the Minnesota Gas & Electric Company, at Albert Lea, Minn., has been appointed president and manager of the Spokane Heat, Light & Power Company, at Spokane, Wash., succeeding **Harry A. Flood**, who has resigned as president, but remains as president of the holding company, and **E. Darrow**, who has resigned as manager.

Arthur H. Elliott, secretary of the Pacific Coast Electric Supply Jobbers' Association, and **W. L. Goodwin**, formerly vice-president and sales manager of the Pacific States Electric Company, now with the General Electric Company, in New York City, are receiving congratulations of a national flavor for their effective talks on co-operation at the recent national convention of the electric supply jobbers in the East

Francis I. Maslin of the electric distribution department of the Pacific Gas & Electric Company in Oakland; **Lieutenant Edward B. Strong, Jr.**, treasurer of the Technical Publishing Company, publishers of the Journal of Electricity, in San Francisco; **Allan W. Morrow**, of the engineering staff of the Standard Oil Company at Richmond, and **Chas. Z. Yost**, of the engineering staff of the Pacific Gas & Electric Company, in San Francisco, are among those who have recently taken unto themselves blushing brides.

OBITUARY

Arthur Gunn, president and manager of the Wenatchee Valley Gas & Electric Co., and the first president of the Northwest Electric Light & Power Association, was killed at Wenatchee, Washington, May 24, 1917, by the overturning of his automobile; it is thought that death was instantaneous. He was beloved by all who knew him and in the Northwest his loss is so keenly felt that the Northwest Electric Light & Power Association has issued cards of mourning expressing to the wife and children of Arthur Gunn the deep sympathy and condolence of its members.

TRADE NOTES

The Sangamo Electric Company of Springfield, Illinois, announce the opening of a San Francisco office at 37 Stevenson Street, in charge of L. A. Nott, district manager. This office will represent the Sangamo Company in Northern California and that part of Southern California not handled by the Sangamo Company's Los Angeles office.

The United Trading Company, recently incorporated by Max Loewenthal, formerly with the Dohrmann Commercial Company, Emil Greenebaum and Joseph Thieben, are western representatives of several eastern electrical manufacturers. These include the Menominee Electric Manufacturing Company, manufacturers of power motors, fans, bells, telegraph outfits, sewing machine motors, etc., the Pittsburgh Electric Specialties Company, making spotlights, drink mixers, vacuum cleaners, etc., the Swedish-American Telephone Company and the Ruvio Electric Company. Offices are at 595 Mission street, San Francisco, and 942 So. Hill street, Los Angeles.

MEETING NOTICES FOR ELECTRICAL MEN

(Two important events, one in the past two-week period and the other three weeks ahead, occupy the talk of men of the electrical industry in central California. The past event is that of the Alameda County Jovians and their recent successful entertainment, and the one ahead is the forthcoming meeting of the California Association of Electrical Contractors & Dealers at Santa Cruz, for which enthusiastic preparation is being made. In other parts of the West, meetings of interest to electrical men are being held. In the following pages items of interest along these lines may be found.—The Editor.)

The Alameda County Jovian Club

Men of the electrical industry in central California must take off their hats to the Alameda County Jovians for their wonderful ability at entertaining and creating friendly feeling among men of the industry. The first foreshadowing of the coming enthusiasm of this organization was shown on Wednesday, May 23 at the San Francisco Electrical Development & Jovian League when the San Francisco organization was taken by storm by men of Oakland, and the friendly way in which bids were given for the "get-to-gether" on May 30 was sufficient in itself to assure a large attendance.

On the evening set for the occasion the Alameda County Electrical Club, one of the many offshoots of the chamber of commerce, entertained 250 electrical men at their second annual smoker at the Hotel Oakland.

Pleasing to the electrical fraternity was the large attendance of "Jovians," over a hundred attending in a body from San Francisco. A splendid program, arranged by Messrs. Martinez, Kann and Woodward, sent the crowd away, happy and awaiting the time for the next affair. San Francisco promises in the near future to put on a Jovian night at the St. Francis Hotel, and will ask Oakland electrical men to be their guests. The electrical organizations in the bay cities are pulling together.

The electrical flag and the flashes of illumination exhibiting the wonders of Aladdin added much to the success of the affair.

BUILDERS OF THE WEST—VII

CHAS. C. MOORE

As long as children's prattle continues to picture the wonderful doings in fairyland, in Aladdin's Cave and the other host of wondrous happenings in the gorgeous imagination of the young, so long will the dazzling beauty of the Tower of Jewels, the splendor of restful setting backed by a glorious expanse of world-reaching waterway, continue to play in the descriptive imagination of the father, in his effort to transmit to the child, some conception of the inspiration that comes from a contemplation of the works of man as brought out in the great Panama-Pacific International Exposition at San Francisco in 1915. To Chas. C. Moore, brilliant executive and builder—this issue of the Journal is affectionately dedicated in appreciation of the ever-living service he rendered to the West as president of the Panama-Pacific International Exposition.

The California Association of Electrical Contractors & Dealers.

From July 11 to 14, 1917, the city of Santa Cruz will be in possession of the California Association of Electrical Contractors and Dealers for its 1917 Convention. Program for the meeting, which promises to be the largest of any yet held, is now being arranged. Subjects of importance to the various local sections all over the State are scheduled for consideration and discussion, among them universal adoption of trade acceptances; examinations for electrical men; practical newspaper advertising construction; essentials of cost accounting; every-day problems of the contractor and contractor-dealer; questions worrying the electrical retailer.

Men prominent in various walks of commercial life have already signified their intention of being present and addressing the gathering. The central station men are going to be on hand in larger numbers than ever, as will also the jobbers and manufacturers.

San Francisco Electrical Development & Jovian League

Wednesday, May 30, being the National Memorial Day and a public holiday no meeting of the league was held.

On Wednesday, June 6, was held the most largely attended and most enthusiastic meeting of the year. S. M. Kennedy of the Southern California Edison Company brought greetings from the south and in a fitting manner closed with a tribute to the ever-growing ideal of co-operation so noticeable among men of the electrical fraternity. Stanley Walton, of the Pacific Gas & Electric Company, as chairman of the commercial committee of the Pacific Coast Section N. E. L. A., outlined the proposed activities for the year, which are given in detail on page 445 of June 1st issue, Journal of Electricity. Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, was speaker of the day and chose as his subject "The War's Effect on the Electrical Business." Dr. Addison, though eloquent and forceful in all his speaking in the past, was never more beautifully effective, than in his soul stirring remarks at this League meeting. E. O. Shreve, of the General Electric Company, acted as chairman of the day.

San Francisco Engineer's Club

The San Francisco Engineer's Club, held its weekly luncheon talk on Thursday, May 31st in the club rooms at the Mechanics' Institute Building. The program was given over to the Boy Scout movement. Several young scouts well exemplified the training acquired among the membership by exhibiting methods of bridge building, mapping and first aid treatment.

On Thursday, June 7, W. H. Shockley spoke on his travels with Mandarins in North China in 1897-1899. Mr. Shockley described in his own interesting way his personal experiences in an exploration party into northern China.

Los Angeles Jovian Electric League

Professor A. T. Atkins, psychologist, was the speaker at the May 23d meeting of the League. Prof. Atkins aimed to show that an analysis of an employe's mind by the psychologist is perhaps of greater import to the employer than a report on the body by a physician. His talk was illustrated by pictorial charts on phrenology. Several Jovian heads were carefully inspected with some startling discoveries, which served as a good object lesson to all present. Short talks were given by Cora B. Taylor and Elizabeth McManus on the subjects of public instruction and social service respectively. F. T. Maessen was chairman of the day and

his finish was an exceptional entertainment by Senor Serafin Pla, Grand Opera Baratone. The attendance was not large but very sympathetic.

Meeting of Electrical Council of Underwriters' Laboratories

The second meeting of the newly organized Electrical Council of Underwriters' Laboratories was held at the principal office and testing station at Chicago, Wednesday and Thursday, May 23 and 24.

L. A. Barley, Rocky Mountain Fire Underwriters' Association, Denver, Col., C. W. Mitchell, Board of Fire Underwriters of the Pacific, San Francisco, were in attendance.

The large and very representative attendance together with the interest displayed in all of the discussions furnish additional evidence of the important part which this Council is destined to play both in the electrical work of Underwriters' Laboratories and in the electrical industry as a whole.

A. I. E. E. Meetings

At the meeting of the board of directors of the American Institute of Electrical Engineers, held on May 18, information received from various sources indicated that, on account of the national situation, many active members of the Institute who usually attend conventions will not be able to spare the time to attend the scheduled four-day annual convention at Hot Springs, Va. Many of the Institute members have already received commissions in the Engineer Officers' Reserve Corps of the Army, and a large number are, or soon will be, rendering service to the government in various other capacities. The directors therefore voted to cancel the 1917 annual convention.

The directors also voted to hold an Institute meeting in New York, June 27 and 28, for the presentation and discussion of the papers that were to have been presented at the annual convention. Details of the program will appear later.

The following men in the West have been elected associates of the Institute:

Ralph B. Adams, telephone engineer, U. S. Forest Service. ....Missoula, Mont.
Comer P. Altland, efficiency clerk, Pacific Gas & Electric Co. ....San Francisco, Cal.
Clive Everett Baugh, electrician, Pacific Gas & Electric Company ....San Francisco, Cal.
Halvor Willard Benneche, foreman station construction, Anaconda Copper Mining Co....Great Falls, Mont.
E. E. Berg, system operator, Washington Water Power Co ....Spokane, Wash.
Donald Joseph Russell Berkman, instructor in electrical and mechanical engineering, University of Santa Clara, ...Santa Clara, Cal.
John Tunison Brown, foreman, station constructing electricians, Pacific Gas & Electric Co....San Francisco Cal.
Walter J. Dodge, engineer, Pacific Telephone & Telegraph Company ....San Francisco, Cal.
Stephen E. Dunn, electrical student, University of California. ....Berkeley, Cal.
John Winthrop Ellis, hydraulic operator, Mt. Whitney Power & Electric Co....Hammond, Cal
Louis Grant Gomez, telephone expert, Public Utilities Commission of the State of Colorado....Denver, Colo.
William King Hale, assistant to electrical engineer, Mountain States Telephone & Telegraph Co....Denver, Colo.
Dean R. Hart, electrical mechanic, Washington Water Power Company ....Spokane, Wash.
Roy Thorpe Hazzard, hydraulic operator, Mt. Whitney Power & Electric Co....Hammond, Cal.
Edward Clinton Jansen, chief engineer, Colorado Power Company ....Denver, Colo
Leo C. Johnson, electrical mechanic, Washington Water Power Company ....Spokane, Wash.
Emil Albert Marklewitz, commercial engineer's office, Mountain States Tel. & Tel. Co....Denver, Colo.
William Angus Mitchell, electrical engineer, Great Western Sugar Co. ....Denver, Colo.
Tukuro, Nakagawa, chief engineer, Okumura Electric Co.; lecturer Kyoto Imperial University....Kyoto, Japan
Louis Joseph Nevraumont, operator, Pacific Gas & Electric Company ....San Francisco, Cal.
Joseph Barstow Nichols, superintendent, Paulsen Building ....Spokane, Wash.
Bernhard Olsen, sales agent, General Elec. Co..Spokane, Wash.
W. P. L'Hommedieu, manager, Railway & Lighting Div., Westinghouse Electric & Mfg. Co....San Francisco, Cal.
Barrett Morris Merrill, assistant superintendent Light & Power System, Wash. Water Power Co....Spokane, Wash.
Royal Daniel Sloan, instructor in electrical engineering, Montana State College....Bozeman, Mont.
Harold Nelson Walker, electrical engineer, Washington Water Power Co....Spokane, Wash.
George I. Wright, foreman substation construction, Southern Pacific Co....Portland, Ore.
Roy Conrad Zoll, electrical tester, Bureau of Power and Light, City of Los Angeles....Los Angeles, Cal.

Congress of Engineers of Norwegian Birth

An informal congress and re-union of American and Canadian engineers and architects of Norwegian birth or descent, is to be held in Chicago from Thursday, September 27th, to Saturday, September 29th, 1917, at Chicago Norske Klub, 2346-2350 North Kedzie boulevard, Logan Square, Chicago, U. S. A.

National Convention of Electrical Supply Jobbers

At the concluding sessions of the meeting of the Electrical Supply Jobbers' Association at Hot Springs, Va., last week, inspirational and thoughtful addresses were made by Arhur H. Elliott of Oakland, Cal., secretary of the Pacific Division of the association, and W. L. Goodwin, formerly vice-president and sales manager of the Pacific States Electric Company and now with the General Electric Company in New York City. The former told of electrical commercial conditions on the Pacific Coast in a very interesting manner. The latter spoke of his recent work among the jobbers and contractors in New York City, and the situation he unearthed came as a revelation.

Mr. Goodwin's reputation as an organizer and the excellent work he did for the electrical industry on the Pacific Coast are very well known, so that his remarks were listened to with a great deal of attention.

A Benefit Plan for Jovians

A new benefit plan for Jovians has been effected for the Jovian Order as follows:

No. 1. Any Jovian in good standing may by application to the Jovian Central office now secure accident insurance, substantially identical with the twenty-five dollar policies issued by the three largest accident companies, upon payment of a premium of only twelve dollars,—net saving thirteen dollars.

No. 2. Or, in the same manner a Jovian may secure health insurance of a market value of thirty-five dollars for twenty dollars—net saving fifteen dollars.

No. 3. Or, one accident and one health policy,—net saving twenty-eight dollars.

No. 4. Or, two accident policies,—net saving twenty-six dollars.

No. 5. Or, two accident and one health policy,—net saving forty-one dollars.

NEW BULLETINS

Sandstone quarrying in the United States is discussed in a very useful and helpful manner in bulletin 124 of the U. S. Bureau of Mines, just issued.

New bulletins of the Crocker-Wheeler Company are No. 177 entitled "Form W Rolling-Mill Motors" for 220 or 230 volts, direct current in sizes from 6½ to 200 h.p. and No. 178 entitled "Three-wire Distribution" which sets forth the advantages and methods to be followed in this system of distribution.

"Booklet E" is the title of the new 32-page booklet just published by The Cutler-Hammer Mfg. Company, Milwaukee, describing C-H Control Equipment for Electric Elevators. This booklet covers the various classes of control, such as hand rope control, car switch control, push button control, for all classes of freight and passenger service.

The General Electric Company has just issued Bulletin No. 43503 on "The Application of Novalux Units to Ornamental Street Lighting." The bulletin is attractively prepared, containing 36 pages fully illustrating the correct lighting units for business streets, residential streets and outlying districts.

Excellent bulletins on poultry as a means of conserving the food supply, and irrigation of rice in California have recently been issued by the college of agriculture of the University of California. Other useful pamphlets are entitled: Drying winter vegetables, canning fruits without sugar, preservation of fresh eggs, and preservation of vegetables by salt and fermentation.

OF INTEREST TO UTILITY COMPANIES

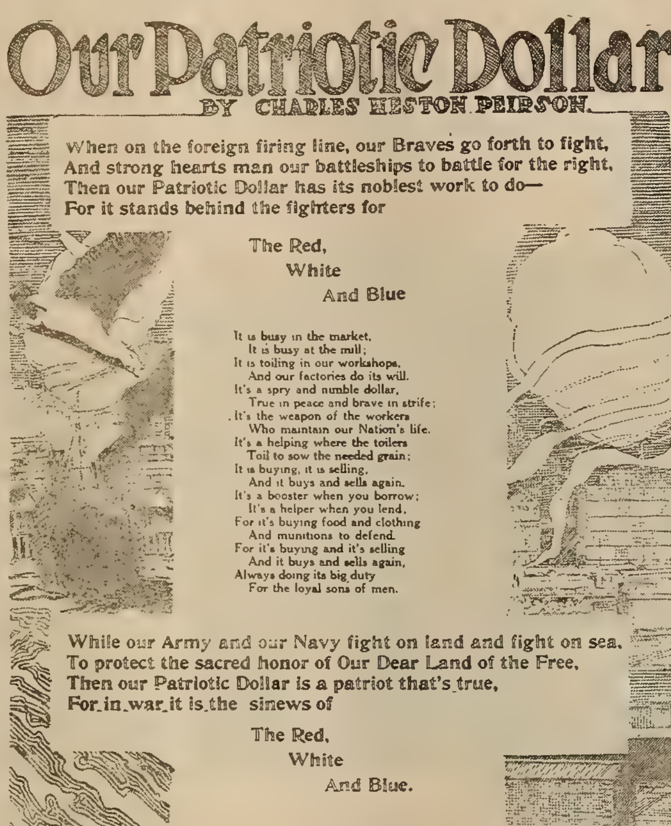
(Reorganization of the Southern California Edison Company in its personnel is one of the striking features of the past semi-monthly period. Financial notes, increase of dividends, extension of service, and a statement of increase accounts constitute other items of interest to utility companies throughout the West, briefs of which may be found on this page.—The Editor.)

Reorganization of Southern California Edison Company

The consolidation effected by the Southern California Edison Company and the Pacific Light & Power Corporation has been completed in its various details, and at a special meeting of the new board of directors the following officers were elected: President John B. Miller; vice-president and general manager, W. A. Brackenridge; vice-president and assistant general manager, R. H. Ballard; other vice-presidents, George C. Ward, formerly vice-president of the Pacific Light & Power Corporation, George I. Cochran, J. C. Drake and William R. Staats; general counsel, H. H. Trowbridge; general agent, S. M. Kennedy; comptroller, A. N. Kemp; treasurer, W. L. Percey; secretary A. E. Morphy; general superintendent of the southern division, B. F. Pearson; general superintendent of the northern division, E. R. Davis; purchasing agent, John Otto; assistant comptroller, D. M. Trott; assistant treasurer, B. T. Story; auditor, C. P. Staal.

The new board of directors is composed of John B. Miller, H. E. Huntington, W. A. Brackenridge, Albert W. Harris, W. E. Dunn, George I. Cochran, J. C. Drake, William R. Staats, Arthur H. Fleming, Henry M. Robinson, J. H. Fisher and Howard E. Huntington.

Connecting the two physical systems and merging of the two operating departments will be undertaken at once and will be completed within the next few months.



AN INSTANCE OF UTILITY SERVICE IN MAINTAINING PUBLIC CONFIDENCE

Here is a forceful instance of how utility companies of the West are assisting in injecting optimistic publicity in the newspapers and thus counteract a tendency to economize or to "put coin in the teapot," which is apt to occur as a result of increased cost of staples and war taxes.

Great Western Power Company

Great Western Power Company, operating in Oakland, Petaluma, Santa Rosa, Napa, Rio Vista, Sacramento, Berkeley, Richmond and various other small towns, has reported to the Railroad Commission the following figures:

Income Account	
Operating revenue	$2,898,818.38
Operating expenses	760,075.32
Net operating revenue	$2,138,743.06
Non-operating revenue	252,337.98
Gross corporate income	$2,391,081.04
Deductions	
Non-operating revenue	$ 24,479.80
Interest on funded debt	1,085 200.00
Other interest	7,885.33
Rent	295,633.17
Total	$1,432,623.40
Net corporate income	958,657.64
Dividends	357,500.00
Miscellaneous additions	129,593.34
Miscellaneous deductions	1,419,474.75
Surplus, December 31, 1915	1,668,545.37
Surplus, December 31, 1916	979,821.60

The Pacific Gas & Electric Company

At the recent annual meeting of stockholders of the Pacific Gas & Electric Company, San Francisco, A. F. Hockenbeamer, vice-president and treasurer, showed that, notwithstanding the cessation of the temporary exposition revenue of 1915, the gross business in 1916 increased $85,000 over the total of 1915.

Regarding the new development work on the Pit River announced in the last issue of the Journal of Electricity, the present construction schedule calls for the following expenditures: First year, $300,000; second year, $1,500,000; third year, $2,000,000; fourth year, $7,000,000; fifth year, $6,700,000; total, $17,500,000. Waterwheels and generators are to be purchased last so as to afford the advantage of such improvements in design as may take place.

Dividend of Montana Power Co.

The Montana Power Company has declared a quarterly dividend of 1¼ per cent on common, and a regular quarterly dividend of 1¾ per cent on preferred, both payable July 2 to stock of record June 15. This places common stock on a 5 per cent annual basis, compared with 4 per cent heretofore.

Extension of Washington Power Co. Service

The Washington Water Power Company, Spokane, Wash., is negotiating with mine operators in the north side of the Coeur d'Alene region to furnish power for the operation of mines and mills. Line construction and transformer installation would involve an expenditure of $50,000, according to M. C. Osborn, commercial agent for the company. The lines would total 25 miles. Extensive development of properties in that region has been retarded by lack of power.

Northwest Electrification Progressing

That part of the Chicago, Milwaukee & St Paul Railroad between Harlowton, Mont., and Avery, Idaho, a distance of 437 miles, is now being operated as an electric line. Electric power is supplied by various plants of the Montana Power Company, the largest two of these being at Great Falls, Mont., and Thompson Falls, Mont. The first electric train was moved in December, 1915, and the last steam-operated train was taken off the Missoula division in February, 1917. On that division is the St. Paul Pass tunnel, which cuts through the summit of the Bitter Root mountain range near the Montana-Idaho line, and has a length of 8000 ft. This was concrete lined throughout before the line through it was electrified.

The work of electrifying another division, of 217 miles, began about May 16, 1917. The starting point is at Othello,

100 miles east of Cle Elum. The electrification will proceed westerly to Seattle and Tacoma. The character of construction will be the same as that on the Rocky Mountain division. There will be eight substations, at Taunton, Doris, Kittitas, Cle Elum, Hyak, Cedar Falls, Renton and Tacoma. Power will be furnished by the Intermountain Power Company. It is figured that the work will be completed between Cle Elum and Seattle and Tacoma before the close of 1918. This work is in direct charge of R. Beeuwkes, electrical engineer.

California Commission Notes

The Key Route Company, which operates extensive interurban lines out of San Francisco, recently asked the Railroad Commission to give it a rate hearing, declaring that it wants to raise its passenger fare for ferry and interurban service on the ground that the present rates are too unreasonably low to return the company a fair interest on its investment. The petition asserts that the value of the operative property devoted exclusively to the service mentioned is $8,304,104, and that its total earnings from this source for the sixteen months past were $1,595,043. Its operating expenses and taxes were $1,336,893, leaving net earnings of $258,150. Bond interest and fixed charges are set down at $485,598, leaving a deficit of $227,447. The applicant adds to this a special charge of $237,442 for the abandonment of an old pier trestle and puts down a total deficit of $489,071 for sixteen months' operation of the Key Route ferry service and local lines.

Public Service Commission of Oregon

In a decision handed down on May 21, the Public Service Commission of Oregon ordered a reduction in the light and power rates of the Portland Railway, Light & Power Company.

This decision came as a result of a succession of investigations, valuations and hearings that have been held during several years past. The reduction on domestic lighting will amount to between 10 and 15 per cent, or from $60,000 to $65,000 a year, according to estimates made by the commission. If the Northwestern Electric Company, a competitive concern, meets the new rates, another $10,000 or $12,000 a year will be cut off from the domestic service charges in Portland.

The Portland Railway, Light & Power Company has announced publicly that it will accept the rates, although it is thought that they will work some hardship on the company. It is not yet apparent that the order applies to the rates of the Northwestern Electric Company.

As a general proposition, the commission decided that while the company at present was not earning a fair return on its investment, it felt that the main reason for this was the competitive condition that existed and, inasmuch as the Portland company was not meeting its competitor's rates, it could not put forward the excuse that it was not getting a fair return.

The California-Oregon Power Company is seeking in the United States Court an injunction against city officials of Klamath Falls, Ore., to prevent them from submitting an ordinance on the June ballot granting a franchise to a competing electric light and power company. The company alleges that the proposed franchise cannot be legally placed on the ballot because it was prepared in violation of the city charter. It is further declared that the cost of the election would add to expenses of taxpayers, of which it is one of the heaviest. The Keno Power Company is the concern that wishes to enter the field.

THE POWER OF VISUAL INSTRUCTION

Here is an instance of how the psychology of visual instruction is made use of to make a deep imprint upon every beholder. In this window display, the very romance of life itself is made to set forth the on sweeping victory of electrical applications. The educative value of visual instruction is coming more and more into prominence among our great institutions of learning. Utility companies throughout the West will do well to make use of its value in every way possible as was done in this instance by a great ultility company in Southern California.

Western States to Spend a Million

Western States Gas & Electric Co., a subsidiary of the Standard Gas & Electric Co., is to enlarge its hydroelectric generating plant on the American River, nine miles above Placerville, Cal., and expects to eventually increase the present 8,000 horse-power capacity to 40,000. Additional water storage is necessary, and the company has filed with the California State Water Commission an application to be allowed to add 20,000 acre feet to the storage capacity of the three lakes situated above the plant. Ultimately the company plans to spend $1,000,000 on this enterprise.

RECORD WESTINGHOUSE EARNINGS

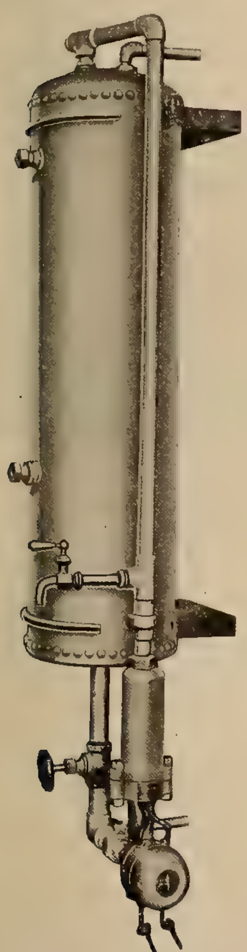
Never before in its history has the Westinghouse Electric & Manufacturing Co. been able to report so prosperous a period as the twelve months ended March 31. Gross sales were $89,539,442, against $50,269,240 last year, and after charging off $6,473,066 for depreciation and betterments, paying $768,348 interest and adding $1,386,547 there remained $18,079,888 applicable to dividends on the capital stock outstanding. This was equal to $15.10 on each $50 share then outstanding, against $8.53 in the previous fiscal period. About the close of this year, however, the company sold an additional $15,000,000 in common stock, bringing the amount to $70,813,950, which with the preferred, makes $74,812,650 capital stock now issued. Earnings on this amount of stock in the recent fiscal year equal $12.09, against dividends of $3.50 per annum on both classes.

LATEST IN EVERYTHING ELECTRICAL

(The recent report of the sub-committee on electric water heating for the National Electric Light Association gives a most comprehensive resume of the present status of electric water heating. In this report the Pacific Coast States are seen to take a most enviable lead in their development and use. Below are summarized the salient features of this report and two types of electric heaters there described are appended in this discussion. Other items of recent advance in affairs electrical follow this article.—The Editor.)

PRESENT STATUS OF ELECTRIC WATER HEATING

Electric hot-water service is of vital importance to the introduction of the electric range. Electric ranges are sold on account of greater convenience, cleanliness and safety; it is therefore inconsistent to recommend other methods of water heating, especially since electric water heaters are as far superior to other heaters as electric ranges are to other types. When a central station fails to push electric water heating along with electric cooking it has neglected one-half of the possible revenue from each installation. Further, the load factor of the water heater is far superior to that of the range, and is accordingly entitled to a much better rate.



New Circulating Type of Electric Water Heater

To make water heating successful, four things must be taken into consideration: First, the rate; second, the selection of the heater; third, the proper installation of the heater; fourth, the proper insulation of the storage boiler. With these matters properly handled every installation will be successful.

The report records the number of heaters installed and the connected load as follows:

	Heaters Installed	kw. Connected
Pacific Coast States	2005	2455
Middle States	58	33
New England States	81	243
Total	2144	2731

One station reports the average consumption of water heaters only at 103 kw.-hr. a month, revenue $3.65; range only as 102 kw.-hr. a month, revenue, $3.85; range and water heater combined 242 kw.-hr. a month, revenue $6.65.

Five types of water heaters are now available. They are the instantaneous, automatic circulation, non-automatic circulation, automatic immersion and the non-automatic immersion.

The matter of boiler insulation is of the utmost importance on account of the large radiation losses from uninsulated boilers.

The Thermal Switch

Any circulating-type water heater properly constructed, with the resistors and insulating material now available will give satisfactory service as long as the heating unit is in proper contact with water. Any water heater properly installed with the thermal insulation necessary to high efficiency will fail when the following conditions obtain.

When the heater is allowed to operate until the water is heated to the boiling point and steam, which displaces the water in contact with the heating unit, is generated.

When the circulating pipe, heater or flow-restricting device becomes choked or filled with sediment or scale.

In both cases the conduction of heat from the element is retarded and the temperature rises sufficiently to cause either the insulation or the resistor to fail. Any device designed to limit satisfactorily the temperature of both water and heater will not only insure against heater failures but will add much to the convenience and service of electric water heating.

A thermal switch designed to open and close the heater circuit at predetermined temperatures of the water and arranged to be used in connection with any standard make of circulating-water heater is now giving satisfactory service in many installations. A brass fitting is placed in the circulating pipe just below the heating device. One side or face of this tee is recessed to receive a temperature pressure cell, which is held in close contact with the tee by means of screws that also support the switch contacts and case. This pressure cell is constructed by welding a spring diaphragm to a copper cup. The cell is partially filled with a liquid that has the required boiling point and is then sealed. The contacts are arranged to close by gravity; the upper contact is supported by the movable arm, pivoted, and so adjusted, with regard to the diaphragm of the temperature cell, that the contacts are instantly forced apart a sufficient distance when the temperature reaches the proper point. When the temperature of the tee or fitting is reduced, the pressure cell diaphragm moves back and the contacts instantly close.

This pressure cell is easily replaced and cells of different temperature adjustments can be furnished. The contacts show only slight depreciation when used with water heaters up to and including 6 kilowatts, 220 volts.

When constant hot water service is desirable, efficient thermal insulation is most necessary, and the thermal switch should be so placed in the circulation pipe that any displacement of water by steam or air in the water heater will cause the switch to open. By using a low temperature adjustment and placing the switch as close as possible to the inlet end of the heater with the restriction or flow retarding device on the outlet or hot end, any obstruction in the circulating pipe will cause hot water to be forced into the switch fitting causing the switch to open the circuit.

When the hot water in the storage tank reaches the bottom and passes into the circulating pipe the switch will open. If water is drawn from the tank the switch will at once close and will open again only when the tank is full of hot water or the circulating pipe is closed.

Instantaneous Water Heaters

Two factors have retarded the application of the instantaneous water heater. No method has been provided to limit the current rush the instant the heater is started. This of course results in a pronounced disturbance on the line, which proves very annoying to the lighting customers served from the same transformer or service bus.

The second factor is as serious, but affects only the person who depends for hot water upon a heater using metal

elements. If for any reason the supply of water passing through a heater with a metalic element fails to flow while in use, the temperature of the element becomes so great that damage results and the element is destroyed and requires replacement, which is not only expensive but annoying to the user.

In the designing of the instantaneous heater shown both of the objectionable features mentioned in the preceding paragraph have been overcome. The new electric faucets are of the automatic type and, owing to a radical change in design, the faucet accomplishes its function to a high degree of perfection and efficiency. It is automatic and as nearly fool proof as human ingenuity can make it. The electric switch has been dispensed with entirely and the flowing water makes the electrical connections. Since the water enters at the bottom of the electrodes and rises to the top, the space between the electrodes is gradually filled, thus slowly increasing the current from zero to maximum, and when the water is shut off it gradually drains from the heater reducing the current back to zero in the same manner, thus entirely eliminating the sudden surges so common to the coil type of instantaneous heater. If the water supply should be cut off, no electricity will flow when the faucet is operated, therefore no burn-out can occur. The insulation of the current carrying parts has been given close study and as a result the break-down voltage is 18,500 volts. This insures perfect safety against danger from fire or shock to persons operating the faucet.

Simplicity, which is the keynote of all successful devices, is a marked feature of this appliance, there being practically only four parts, the faucet, the container, and the two carbons which carry the electric energy. The terminals for connecting to the service outlet are brought out at the base where it is screwed to the water pipe. A carbon cylinder and rod shown in the illustration of parts are in turn electrically connected to these terminals and tap water flowing up between both electrodes completes the electric circuit. Thus it is seen that the rate at which the water is heated depends solely upon its rate of flow through the passage between the two carbon electrodes. The nickel cap, enameled on the inside, covers the electrodes and forms a passage for the water to the discharge nozzle. The cap is an electric insulator requiring 8000 volts to break down. Water of almost any temperature up to boiling can be obtained instantaneously. The efficiency is practically 100 per cent, the entire electric energy being transformed into heat.

The passage of the electric current through the water acts as a germicide, and bacteria which are contained in all waters are reduced to a minimum. Another great advantage of this heater is that only one faucet is required for an ordinary lavatory; both hot and cold water can be drawn by the simple operation of turning the handle in one direction for hot water and in the reverse direction for cold.

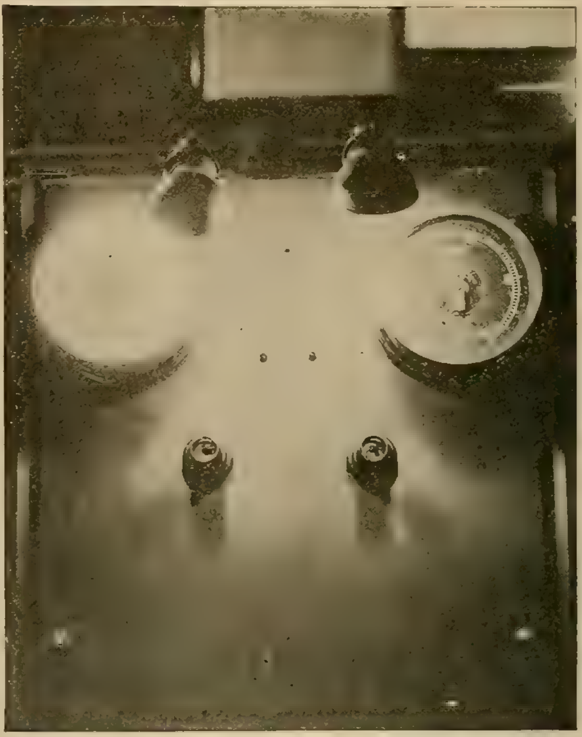
With a large number of these faucets on a central station line, the diversity factor is such as to very slightly increase the total demand on the system or on any single transformer supplying a number of the heaters. While the faucet was primarily intended for the home, it will be found very useful for barber shops, saloons, soda fountains, and in commercial establishments requiring hot water instantaneously.

New Circulating Type of Heater

The principle of this instantaneous heater and of the Kercher thermal switch as hereinbefore described, has been utilized in a new circulating type of electric water heater manufactured by the Automatic Electric Faucet Company Hobart Building, San Francisco. The electrodes can be charged for any current consumption between 800 and 8000 watts. The heater can be quickly attached to any hot-water boiler, has a high thermal efficiency and is made of indestructible material. It represents the last word in electric water heating.

BLACK DIAL TYPE ELECTRIC METERS

Electric meters having black dials with the figures, scale, and pointer in white, were first brought out by the Westinghouse Electric & Manufacturing Company for cab service on electric locomotives. The object in using this type of



The Black Dial Type of Meter

instrument, was to prevent the glare caused by the illumination of white-dial meters in tunnels, which interfered with the reading of signals.

POPULARITY OF ELECTRIC TABLEWARE

Everyone interested or associated in any way with the electrical industry has doubtless observed the phenomenal increase in the use of electric current for other than lighting purposes in the home.

The off-peak load resultant from the more extensive use of electric home conveniences is very gratifying to the central station manager. And electric tableware, which because of its additional use during the summer months when little electric light is used, is chief among the list.

From a merchandising point of view, electric tableware is easy to sell. The idea of "cool cooking" right on the dining or breakfast table appeals quickly. Its advantages, convenience and neatness meet with immediate approval. The fact that most electric current users do not use the maximum for which they are paying during the summer months and that they may enjoy the benefits of electric tableware by using this current without additional expense, quickly sells these appliances.

In the matter of popularizing the use of electric home conveniences, too much credit can not be given the world's largest exclusive manufacturers of electric appliances, the Hotpoint Electric Heating Company of Ontario, Cal. This company is credited with being one of the leaders in improving the serviceability and convenience of electric appliances.

CONDENSITE PATENT RECOGNITION

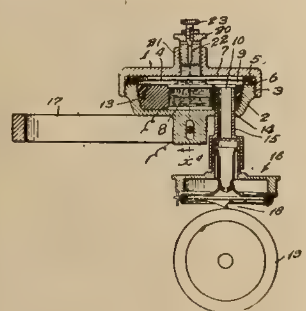
Pending litigation between the Condensite Company of America and the General Bakelite Company has been terminated, and as a result of the settlement the General Bakelite Company agrees to recognize the validity of the Condensite (Aylsworth) patents Nos. 1,065,495, dated June 24, 1913 and 1,137,374, dated April 27, 1915, and to pay substantial royalties thereunder.

WHAT WESTERN INVENTORS ARE DOING

(Many inventors have attempted to utilize electrically transmitted impulses. The field is a broad one and a successful invention would undoubtedly result with much profit to the inventor and vastly forward all phases of radio activity. Below will be found a brief on a recently patented means for utilizing electrically-transmitted impulses as well as patents for a portable electric water-heater, a train-stop and signaling system, a telephone transmitter and mouthpiece, and flash-light apparatus—all by inventors in the West.—The Editor.)

1,225,203. **Means for Utilizing Electrically-Transmitted Impulses.** Edward H. Amet, Redondo Beach, Cal.

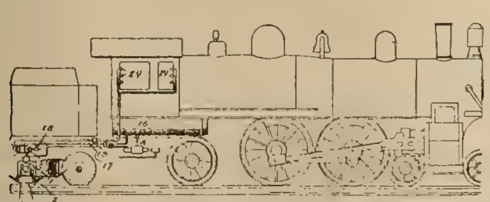
The combination with a telephone receiver diaphragm and electro-magnetic means for operating the diaphragm, of



dash-pot forming means containing air open to atmospheric pressure, means to regulate the size of the chamber, and means to nearly close the opening to the atmosphere.

1,225,508. **Train-Stop and Signaling System.** Hiram G. Sedgwick, Mill Valley, Cal., assignor to The National Safety Appliance Company, a corporation of California.

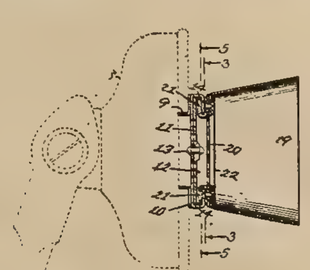
A combination with a railway vehicle, two sets of armatures carried thereby, one set being arranged at each side of the center of the vehicle, two groups of train control devices,



means operated by one set of armatures while the train is going in one direction to actuate the devices of one group and means operated by the other set when the train is going in the opposite direction to actuate the devices of the other group and means to operate each armature independently of all the other armatures.

1,225,672. **Telephone Transmitter and Mouthpiece.** Hitasu Nakai, Havre, Mont.

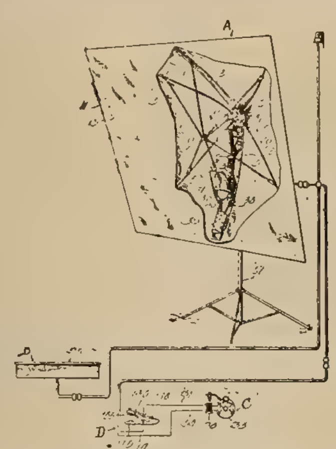
The combination with a telephone transmitter provided with a threaded opening for a mouthpiece, of a casing pro-



vided with a threaded neck engaged in the opening, a mouthpiece in detachable engagement with the casing, and means for preventing the use of the telephone operable by the removal of the detachable mouthpiece.

1,225,261. **Flash-Light Apparatus.** David Charles McCandless, Boise, Idaho.

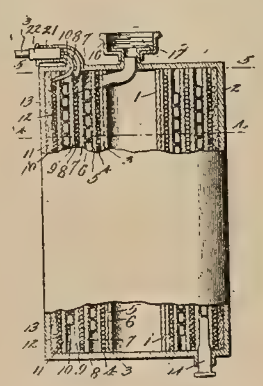
In an apparatus for photographing by artificial light, the combination of a base member composed of upper and lower sections hinged together, a powder pan mounted on the upper section and having in its bottom an opening, a pair of spaced



terminals on the lower section for reception in the opening when the upper section is lowered, the terminals being adapted to be connected by a fuse, and means for supplying electric current to the terminals for blowing the fuse to ignite the contents of the pan.

1,225,631. **Portable Electric Water-Heater.** Clarence E. Hinkle, Roswell, N. Mex.

An electrical water heater including an inner core, an outer casing, a series of sets of electrically insulated resistance units and heating coils disposed between the core and



casing, the coils having a common inlet and common outlet, means for connecting the resistance wires with a source of electric supply and electrical insulating material between the coils and resistance units, said material permitting the free transportation of heat.

NEW ELECTRICAL DEVELOPMENTS

(The continued public confidence manifested in utility securities constitutes the most substantial advance in electrical development during the past semi-monthly period. That these securities are becoming more and more to be recognized as exce lent investments for savings banks may be seen from the first news item set forth below. Other jottings of new electrical developments throughout the West follow.—The Editor.)

FINANCIAL

STOCKTON, CAL.—Samuel Kahn, vice-president and general manager of the Western States Gas & Electric Company, received word that W. R. Williams, State Superintendent of Banks, has approved the Western States Gas & Electric Company's bonds as legal securities for the investment of savings banks.

INCORPORATIONS

LATON, CAL.—The Laton Telephone Company has been incorporated.

GRASS RANGE, MONT.—The Grass Range Farmers' Telephone Company has been incorporated here.

SEATTLE, WASH.—The Skokomish Power Company has been incorporated for $1,000,000 by G. H. Tilden, W. H. Wynn Jr., H. Bunker.

FRESNO, CAL.—The Laton Telephone Company has been incorporated. The incorporators are I. Teilman, T. D. Maryhall and A. G. King. It will operate in Fresno and Kings counties.

TEMPE, ARIZ.—Articles of incorporation have been filed by the Power, Light & Operating Company. The incorporators are E. H. Winkler, Wm. F. Ballard, Chas. E. Ballard and Jas. E. Strikham, all of Oklahoma City, Okla. The principal place of business in the state of Arizona shall be at Phoenix. Capital, $1,000,000.

ILLUMINATION

MESA, ARIZ.—The voters of Mesa have decided to purchase the plant of the South Side Gas & Electric Company.

ELK RIVER, IDAHO.—The town of Bovil will vote on June 9th on an issue of $5500 in bonds for the construction of an electric plant.

PALOUSE, WASH.—At a special election held at Deary it was voted to bond the town for the purpose of installing a municipal electric lighting plant.

PALOUSE, WASH.—At a special election held at Deary Tuesday it was voted to bond the town for the purpose of installing a municipal electric lighting plant.

LODI, CAL.—The Lodi Business Men's Association has accepted the design of City Engineer Barzellofti for the type of concrete electroliers to be used in the residence districts.

DOUGLAS, ARIZ.—An ornamental lighting system is to be installed in the Tenth Street City Park. The council has instructed the city clerk to advertise for bids for the work.

RIVERSIDE, CAL.—A resolution of intention has been passed by the common council for the improvement of Chestnut street from Sixth to First street, and lighting the sidewalks from Eighth to First street.

VENTURA, CAL.—There is a movement on foot here to bring about ornamental street lighting to replace the present primitive system now in use. Oxnard and Fillmore have decided on installing such a system.

SALINAS, CAL.—A resolution of intention has been adopted by the city council for the installation of an electrolier lighting system consisting of 45 electroliers, on Main, Market, North Main and Sausel streets.

COLUSA, CAL.—The trustees have awarded a contract to the Pacific Gas & Electric Company for furnishing light to the city for a term of three years. Provision is made for the installation of a number of additional lights to be scattered throughout the city.

SANTA BARBARA, CAL.—An ordinance has been adopted by the board of supervisors granting the Midland County Public Service Corporation a franchise to lay and maintain a system of gas pipes and to distribute gas along certain highways of Santa Barbara County.

SACRAMENTO, CAL.—A total of 18 cities in the state own their own light plants and these plants earned $842,636.05 in 1916, according to data regarding the earnings of municipally-owned public utilities and their value given in the annual report of the State Controller.

LEWISTON, IDAHO.—An ordinance has been passed by the city council granting the Washington-Idaho Water, Light & Power Company a franchise for a period of 25 years, to construct and maintain within the limits of the city of Lewiston, poles, wires, underground conduits and other structures and the right to furnish power and light.

HUNTINGTON BEACH, CAL.—The board of trustees has awarded a contract for the installation of reinforced concrete gas lighting posts, fitted with gas lamps, brackets, etc., together with the installation of iron pipe conduits and all the accessory fixtures on Main street from Summit avenue to Ocean avenue, to Leigh G. Garnsey on his bid of $13,497.50.

LOS ANGELES, CAL.—To procure for Hill street an ornamental lighting system similar to that to be installed on Broadway and to secure the opening of the street between Washington and West Jefferson, property owners and lessors on the streets have formed an improvement organization of which F. R. Feitshans is temporary president and James Webb temporary secretary and treasurer.

SEATTLE, WASH.—Bids will be opened by the board of public works on July 20 for a $3,000,000 addition to the city light and power system in the shape of a hydroelectric power plant complete with transmission line. The plans provide for a plant capable of delivery in Seattle of 25,000 kilowatts for a period of 5 hours, 10,000 kilowatts for a period of 19 hours and 13,000 kilowatts continuously.

OTHELLO, WASH.—The council met in a special session Monday evening for the purpose of outlining the proposed plan to bond the town of Othello to enable the city's attorney to prepare the legal formalities required for the submitting of the bonding proposition. If the voters authorize the issuance of bonds the town will put in an electric light plant and extend the present water system.

YUMA, ARIZ.—F. E. Trask, a consulting engineer of Los Angeles, has submitted his report to the city of Yuma, Arizona, in which he estimates the cost for a complete new water, light and gas system for that city at a cost of $363,987.52. He also made valuations of the existing water, light and gas plants and found the present value of the physical property to be $162,420.25. He has recommended to the city that a bond issue of $300,000 be made, that the existing plants be purchased, and improvements made to the limit of the bond issue. The subject is now under consideration and a bond issue will be submitted to the voters of the city in the early fall.

TRANSPORTATION

VALLEJO, CAL.—The San Francisco, Napa & Calistoga Electric Railroad Company is about to change its route in the vicinity of Suscol.

ORANGE, CAL.—The Pacific Electric Railroad Company is preparing to erect a modern depot here, the work to begin soon. It is believed that the company will also extend its line to Tustin.

SAN FRANCISCO, CAL.—H. S. Tuttle has been awarded the contract for installing electrical conductors on the Church street line of the Municipal Railways from Market street and Van Ness avenue to Sixteenth and Church streets.

SAN FRANCISCO, CAL.—After extended negotiations between city officials and the United Railroads a compromise has been reached regarding the use of the poles and span wires of the United Railroads by the city on Market street and Van Ness avenue.

SAN FRANCISCO, CAL.—San Francisco-Oakland Terminal Railways announced that it had deposited funds with the Wells-Fargo Nevada National Bank to pay the coupons due July 2, 1916, on the general consolidated 5 per cent bonds of the Oakland Traction Consolidated Company.

EAGLE ROCK, CAL.—The franchise for right-of-way on West Colorado Boulevard for a single street car track across the south half of the street from the present terminus onto the feed yard property, where a depot is to be erected, has been granted to the Glendale & Montrose Railroad.

LOS ANGELES, CAL.—Application has been made to the board of supervisors for a certain franchise, granting right within three years to construct and for a period of forty years to maintain a single-track electric railroad in a certain portion of Los Angeles County. Sealed bids will be received up to June 25th.

TRANSMISSION

PORTERVILLE, CAL.—The Mt. Whitney Power & Electric Company is contemplating building a plant near Camp Nelson. A wagon road will be built to the site.

BRIGHAM CITY, UTAH.—The Phoenix Construction Company has established headquarters in this city and will begin at once the construction of a new transmission line of the Utah Power & Light Company from Grace, Idaho, to Salt Lake.

VENTURA, CAL.—Surveys are being run for a transmission line of the Southern California Edison Company through this county down the Santa Clara Valley, touching at Saticoy, thence over Sexton Ranch and back of the Fraser property to Santa Barbara.

CROCKETT, CAL.—General Manager G. M. Rolph of the California-Hawaiian Sugar Company has stated that more electrical equipment will be added at the refinery here and that the entire mill will eventually be operated by electricity from the central power plant.

MARSHFIELD, ORE.—Manager A. L. Martin of the Oregon Power Company, states that the construction of the high power line to carry electricity from the Smith mills to supply Coquille and Mrytle Point will begin early in June. The line will cost upwards of $25,000 and take two months to build.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company will construct a frame substation building at First avenue south and Spokane street in the near future, having a motor generator with a 500 kw. capacity to be increased later to 1000 kw. The building and equipment will cost $12,000.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company has announced the completion of plans to bring hydroelectric power on high tension lines to this city. The cost of construction of the proposed line is estimated at about $200,000. There will be a reducing plant which will fit the current to city needs.

PORTLAND, ORE.—The county commissioners have granted a franchise to the Portland Railway, Light & Power Company to construct and operate a transmission line along the Columbia Highway for a period of 25 years. The company agrees to operate a line of 11,000 voltage in order to supply the demand of prospective consumers along the highway.

NORTH BEND, ORE.—A. L. Martin, manager of the Oregon Power Company, has received instructions from H. M. Byllesby & Company, of Chicago, to proceed with his plans for building a power extension to Coquille. Mr. Martin also received orders to build a system in Eastside where the company recently was given a franchise. The power wire will cost $25,000.

POCATELLO, IDAHO.—Joseph Burns has made a proposition to the city council providing for the installation of an hydroelectric plant with a capacity of 1500 kw., substation and transmission lines and to sell current at the rate of one-half cent per kw.-hr. His plan is for the city to allow him the contract to furnish the city of Pocatello with current and at the end of 20 years he is to turn over the plant to the city at a normal figure. The matter was referred to the highway and light committees.

TELEPHONE AND TELEGRAPH

NOGALES, CAL.—W. F. Neill is moving to establish in the Vaughn-Elgin region, a local telephone line such as that at Soneita and vicinity.

WALLA WALLA, WASH.—The board of county commissioners has granted a 50 year franchise to the Pacific Power & Light Company to construct and operate electric, telephone and telegraph wires along certain county roads in Walla Walla County.

PENDLETON, ORE.—According to Ed. Mable, manager of the Pendleton telephone office, a new toll line will be constructed from here to the Washington state line and the cost will be $9550. This will include the stringing of 7.2 miles of No. 10 iron wire.

SAUSALITO, CAL.—Application has been made to the board of trustees by the Pacific Telephone & Telegraph Company for a franchise to do a general telephone and telegraph business in this city. Sealed bids will be received for the proposed franchise on July 16th.

OXNARD, CAL.—The Oxnard Home Telephone Company will abandon its present location in the A. Levy building. A complete new switchboard, new charging machine and new up-to-date equipment will be installed in the new location and the present plant will be entirely abandoned and dismantled.

SAN LUIS OBISPO, CAL.—Local Manager Manning of the Pacific Telephone & Telegraph Company has been notified that a corporation has made arrangements for improving its system in this city, including an additional line to Avila and installing central office equipment at Atascadero Colony. The sum of $12,170 covers the cost of placing the exchange aerial cable and the replacement of the pole lines. About $1280 will be expended to place one additional circuit together with miscellaneous exchange pole line reconstruction between San Luis and Avila.

LOS ANELES, CAL.—Funds for actual consolidation of the Home and Pacific telephone systems in Los Angeles have been set aside by the directors of the new Southern California Telephone Company, who have voted approximately $750,000 for this work. More than $250,000 of this amount will be required for new switchboards, additional sections to existing boards, trunks and other equipment. About $14,200 will be expended on the long distance system and requirements for private branches on the part of stores and corporations accounts for about $30,000. Appropriations of approximately $250,000 have been made for the circuit on the trunk lines between the various Home and Pacific exchanges.

IRRIGATION

PHOENIX, ARIZ.—The eastern canal beyond Mesa, is to be enlarged to supply water to large tracts outside of the valley irrigation project.

SUSANVILLE, CAL.—The electors of Baxter Creek Irrigation District by almost an unanimous vote decided to bond the district in the sum of $310,000.

WILLOWS, CAL.—A petition has been filed for the formation of the Jacinto Irrigation District and will be taken up by the supervisors at their June session.

LASSEN, CAL.—With the voting of a bond issue of $810,000, the directors of the Baxter Creek Irrigation District are making every effort to rush the project to completion by January 1, 1918.

OROVILLE, CAL.—The Dudley Ranch and Orchard Company owns 700 acres of land in the vicinity of Central House and plans extensive improvements and will put in a fine irrigating system.

VISALIA, CAL.—As the result of a Railroad Commission order lowering power rates in Tulare County, about 500 pumping plants will be started and an immense amount of irrigation will be done.

SACRAMENTO, CAL.—The governor has signed the California Irrigation Act, providing for the co-operation between the state and government in the storage and division of waters for irrigation purposes.

SACRAMENTO, CAL.—State Engineer McClure and his assistant, Major Norboe, have been called to Scott Valley, in Siskiyou County, to examine a proposed irrigation district that will place a large section of valuable agricultural land under more intensive cultivation.

SALEM, ORE.—The contracts for the furnishing and installation of the equipment for the addition to the city auxiliary steam power plant has been awarded to the C. C. Moore Company, Mutual Life Building, on its bid of $219,000. The company will also take bonds in payment.

OROVILLE, CAL.—For the preliminary expense of organizing an irrigation district, containing 30,000 acres and making the necessary preliminary surveys, the landowners in the proposed district have subscribed $2125 and the business men of Oroville $370, making a total of $2500.

REDDING, CAL.—The Anderson Cottonwood irrigation district has voted to sell $575,000 more bonds to complete the system. This district was already bonded for $350,000. Much of the district will be covered with water by July 1, and the entire system will be completed in another year.

BRAWLEY, CAL.—Mark Rose's Laguna Water Company scheme to irrigate east side Mesa is likely to go through. It is expected that the contract will be signed between the interior department and the Laguna Water Company, providing for financing the scheme by sale of stock of the company.

SUSANVILLE, CAL.—Bonds of $310,000 have been voted by the Baxter Creek Irrigation District. This district comprises 8000 acres ten miles from this city. The $310,000 is to be used in constructing canals, acquiring rights of way and water rights. The bonds will bear interest at the rate of 6 per cent per annum.

PORTERVILLE, CAL.—A total of $601,300 was turned over to the officials of the Terra Bella Irrigation District by the Commercial Trust and Savings Bank in Los Angeles, representing the Aronson-Gale Company of that city, who bought the recently issued bonds of the district. The bonds sold at 97 and netted $68,000, the district cashing interest coupons for the difference.

PRESCOTT, ARIZ.—A bedrock dam has been constructed by the Tres Alamos Land & Irrigation Company about 20 miles west of Congress Junction. The dam is built 80 ft. above the surface and will store water to irrigate about 7000 acres of land. Below the dam is a catch basin to catch the overflow and here a dam 50 ft. high will be put in from which electric power will be generated.

AUBURN, CAL.—The newly organized Horne Development Company of Auburn, Placer County, has filed an application with the State Water Commission to appropriate 20 second feet of the waters of Painter Creek and Buckhorn Creek, in Lassen County, for the irrigation of 9055 acres in that vicinity, where the company plans the establishment of a colony of small ranches. The estimated cost of the project is given at $71,000.

LODI, CAL.—A committee of seven land owners has been appointed to form a Wright Irrigation District in the neighborhood of Lafayette to provide a supply of water for irrigators in the section who have heretofore been using the Stockton-Mokelumne Canal Irrigation system. The committee is composed of E. M. Elliott, J. M. Posey, W. S. Watson, Fred Villinger, W. C. Brown, Frank Perrott and Henry Blohm.

SACRAMENTO, CAL.—The proposed Scott Valley Irrigation District of 5558 acres in Siskiyou County, will be reported upon as feasible by the State Department of Engineering. This is the statement of Major Paul M. Norboe, assistant state engineer, following an inspection of the district by himself and State Engineer W. F. McClure. A petition for the formation of the district, it is expected, will be acted upon by the Siskiyou board of supervisors June 4th.

PARADISE, CAL.—Individual contracts, totaling $172,962, for the construction of the greater part of the system of the Paradise irrigation district have been awarded to W. A. Kraner of San Francisco by the directors. The landowners in the district voted bonds for $350,000 for the construction work. Kraner's contracts were awarded on the following basis: Main canal dam to head of pipe system, $11,375; redwood stave and steel banded pipe, 32 miles, $129,962; balancing reservoirs, pumping station, pressure controls, valves and fittings, $31,625.

SACRAMENTO, CAL.—At a meeting of the Sacramento Valley Development Association held in Chico, W. A. Beard, general manager, in a special report, told of the work that the association could do in the matter of increasing production, by helping to extend the area of irrigated lands in the Sacramento Valley. He called attention to the fact that through the efforts of the association, 6000 or 7000 additional acres are to be irrigated this year by the Orland project. He recommended that steps be taken immediately for increasing the irrigated area in 1918, and that a special committee be named for this purpose.

CHICO, CAL.—Among the topics discussed at a recent meeting of the Sacramento Valley Improvement Board was the Iron Canyon project, already surveyed and reported favorably by the United States Reclamation Service and recognized by the federal government, is expected to provide in its full development for the irrigation of approximately 225,000 acres of Sacramento Valley land. A resolution was presented by W. A. Beard to appoint committees in each of the valley counties to study and report on plans to utilize a great deal of water available for irrigation, but now going to waste. It is proposed to evolve some plan to bring a greater area under irrigation for next season.

LODI, CAL.—A Wright irrigation district will be formed in the section around Lafayette, a few miles west of this city, if the plans of the committee are carried out. The committee met here and formed a permanent organization, electing E. M. Elliott president and John Posey, secretary. Representatives of the Stockton-Mokelumne Canal Company promised the new district the first refusal of the present irrigation system, provided they were able to show results in three days. It is the intention to form a district composed of 20,000 acres, and additional acreage can be added later. It will be necessary to raise about $300,000 to purchase the present system and leave a working capital in the hands of the treasurer. With 20,000 acres in the district it will mean a tax of $15 per acre.